Advances in Implant Therapy: Immediate Implant Placement and Restoration

Harold S. Baumgarten, DMD, Alan M. Meltzer, DMD, MScD, Lee R. Walker, MD, DMD, Robert A. del Castillo, DMD, Ernesto A. Lee, DMD — Page 2
Immediate implant placement and provisional restoration serve to provide shorter treatment times than alternative protocols do and are intended to preserve alveolar bone as well as to develop and preserve the adjacent soft-tissue architecture. Success and survival rates for immediately placed implants are comparable to those for early and delayed placement implants. In the anterior esthetic zone in particular, great care and planning must precede immediate implant placement. With respect to esthetics, preservation of crestal bone and a natural-looking soft-tissue architecture are essential. Considerations include implant design, the implant-abutment interface, the patient’s biotype, the buccal bone plate and crestal bone position, and positioning of the implant.

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**Disclaimer:** The authors of this course are speakers and clinical consultants for BIOMET 3i.

**ABSTRACT**

Immediate implant placement and provisional restoration serve to provide shorter treatment times than alternative protocols do and are intended to preserve alveolar bone as well as to develop and preserve the adjacent soft-tissue architecture. Success and survival rates for immediately placed implants are comparable to those for early and delayed placement implants. In the anterior esthetic zone in particular, great care and planning must precede immediate implant placement. With respect to esthetics, preservation of crestal bone and a natural-looking soft-tissue architecture are essential. Considerations include implant design, the implant-abutment interface, the patient’s biotype, the buccal bone plate and crestal bone position, and positioning of the implant.

**EDUCATIONAL OBJECTIVES**

The overall goal of this course is to provide the reader with information on immediate implant placement and restoration at extraction sites. On completion of this course, participants will be able to:

1. Describe the rationale for immediate implant placement and restoration.
2. Review the survival and success rates of immediate implant placement.
3. List and describe the factors involved in achieving excellent results in the anterior esthetic zone.
4. Review the influence of implant design and adjunctive restorative and surgical components on short- and long-term functional and esthetic success.

**Introduction**

Since the beginnings of modern dentistry in the late 1700s, much has changed, and with respect to modern implant dentistry, rapid change has occurred since its beginnings around three decades ago. The first root-form endosseous implants were constructed of smooth surface titanium, and early protocols required 2-stage surgery with the implants submerged during osseointegration, then exposed and subsequently restored. The rationale for this lengthy, multi-phase treatment was to leave the implant undisturbed to allow for osseointegration with no risk of loading or exposure to oral bacteria, in the belief that this would negatively impact clinical outcomes. Over time, more sophisticated implant designs and treatment protocols were developed. Currently, protocols include immediate, early, and delayed implant placement depending on the clinical situation, as well as immediate and delayed loading.
Extraction Socket Healing and Bone Resorption

Biologically, without socket preservation or placement of an implant, healing of extraction sites is accompanied by significant vertical and horizontal bone resorption. Schropp et al determined in their study of bone healing that approximately 50% of the ridge width is lost in the first year post-extraction, mainly buccally, and the majority of this within the first 3 months; ridge height is also reduced. Systematic reviews have led to the conclusion that a mean horizontal bone loss (loss of ridge width) of 3.8 mm and a loss of 1.24 mm in vertical bone height can be anticipated at extraction sites in the six months following tooth extraction.

Ridge preservation using mineralized particulate xenografts has been shown in some studies to reduce the vertical and horizontal bone loss at extraction sites. Statistically significant differences in bone resorption were found in a study using bovine bone, with a horizontal bone loss of on average 1.04 mm vs 4.48 mm for ungrafted sites at 4 months post-extraction, and vertical bone loss of 0.46 mm vs 1.54 mm.

The Rationale for Immediate Implant Placement

One of the rationales for immediate implant placement and provisional restoration is preservation of the alveolar bone and adjacent soft-tissue architecture following tooth extraction, together with the achievement of an outcome that is both functional and esthetic. Other objectives include shorter and less invasive treatment. Immediate implant placement should not be performed at sites with non-intact buccal bone plates.

Survival and Success Rates with Immediate Implant Placement and Restoration

High survival and success rates can be achieved with immediate implant placement. In 2008, den Hartog et al reported on a review of 19 studies, finding an overall survival rate after 1 year of 95.5%, with no statistically significant differences for immediate, early or delayed implant placement. A Cochrane review conducted in 2010 analyzed seven clinical trials, finding insufficient evidence favoring immediate, immediate-delayed, or delayed implant placement, while noting that the risk of complications might be higher with immediate implant placement but also that esthetic outcomes might be better.

Immediate provisional restoration, as well as immediate, early, or delayed loading, are also currently performed, with one meta-analysis finding similar success rates and outcomes for all three loading protocols. Grütter et al reported an implant survival rate of 96.7% in a study with 1-5 years of follow-up of immediate implants placed in the anterior esthetic zone that were provisionally restored and not loaded, and implants that were conventionally loaded. Individual studies have also supported the use of immediate and early loading, with success rates for immediate loading of up to over 99% reported for single and multi-unit implant-supported restorations.

In one study in patients ages 16.5-80.4 years (n=195), implants and immediately loaded prostheses were placed, with an overall success rate of 96.7%. Gillot et al found no significant differences in the survival rates for immediately placed, immediately loaded implants (n=352) as compared with delayed placement, immediately loaded implants (n=323) in a study of 113 patients receiving cross-arch maxillary fixed prostheses. At six months, the overall implant survival rate was 99.1% with no significant differences between immediate placement and delayed placement of the implants. A small study by Barbier et al found an implant survival rate of 100% with immediate placement, immediate loading of implants supporting fixed prostheses.

In a systematic review, the 1-year-in-function survival rate for the 15 studies that had included survival data (509 implants in 499 patients) was 95.5%, with no differences between immediate and delayed implant placement or between immediate and delayed loading. For implants with >1 year in function, the survival rate for immediate placement, immediate loading implants was 97.5% vs 92.4% for delayed placement, immediate loading implants (P<0.05).

Recently, a prospective clinical study was conducted by Östman et al to assess the one-year cumulative survival and success rates for 102 immediately loaded, platform-switched implants supporting fixed prostheses in 35
patients. A cumulative survival rate of 99.2% was found.\textsuperscript{14}
In addition to high survival and success rates, esthetic results must also be considered, especially in the anterior esthetic zone.

**Anterior Zone Esthetic Requirements**

Esthetic demands are highest in the anterior esthetic zone, necessitating great care and planning. The adjacent anatomy and teeth (if present) must permit placement of the implant in such a manner as to achieve good outcomes both functionally and esthetically. The ultimate hard tissue and gingival architecture achieved is of particular concern in the anterior esthetic zone, since even a moderate amount of mucosal recession following implant placement or lack of a papillary structure can significantly compromise esthetics and result in dissatisfaction. Based upon a review of publications assessing recession following immediate placement of single implants, up to 27% of cases resulted in recession of >1 mm while a lesser amount of recession was described in the majority of reports.\textsuperscript{15} In a review of 91 studies of at least 1-year duration and a minimum of 10 patients, risk factors for mucosal recession at the facial margin included malpositioning of the implant, a thin biotype, and a thin (or non-intact) buccal bone plate.\textsuperscript{16} The patient’s soft-tissue biotype, crestal bone level, buccal bone plate thickness, available mesio-distal space and biologic width must all be considered.

**Crestal Bone Position**

The position of the crestal bone in the most apical portion of the crown of the tooth to be extracted (ie, at the zenith) and the distance from the bone to the contact point must be determined prior to implant treatment. In cases where the zenith bone level is ≤3 mm, less recession can be anticipated. If the distance from the contact point is ≤5 mm, excellent papillary architecture is achievable (Fig. 1). However, in other cases, the dreaded black triangle may be present due to an absence of papillary architecture.\textsuperscript{17,18} Care must be taken to optimize implant and contact point positioning for esthetic soft-tissue results.\textsuperscript{19}

**Mesio-distal Space**

Sufficient space must be present between adjacent implants, or between an implant and an adjacent tooth, for papillary regeneration to be possible.\textsuperscript{20} If insufficient space is present, it was determined in one study that the inter-implant papilla will be absent with corresponding compromised esthetics.\textsuperscript{18} Inadequate inter-implant space has also been found to be a determinant for increased crestal bone loss.\textsuperscript{21}

**Biotype: Thick vs Thin**

Anesthetic and natural-looking peri-implant soft-tissue architecture is more predictable and easier to achieve in patients with a thick biotype and a flat gingival contour as compared to patients with a thin and scalloped biotype who are more likely to experience mucosal recession. A thicker biotype has also been found recently to be indicative of a thicker buccal bone plate.\textsuperscript{22}

**Buccal Bone Plate Thickness**

Buccal plate thickness at the time of extraction influences horizontal and vertical loss of alveolar bone.\textsuperscript{23} Furthermore, in and of itself, immediate implant placement does not prevent buccal bone plate resorption.\textsuperscript{24} The thickness of the buccal bone crest at the time of immediate implant placement and the width of the horizontal gap between the implant and the buccal bone plate are significant factors for ridge resorption. Sites with thicker buccal bone (>1 mm), and where the horizontal gap is >1 mm and well-filled, experience less ridge resorption.\textsuperscript{25} In addition, Artzi et al also found statistically significantly lower crestal bone resorption at immediate implant sites vs implants placed in healed sockets, with provisional restoration occurring at the time of implant placement. At six months, crestal bone resorption for immediately placed implants and implants placed in healed sockets was an average of 0.18 mm and 0.31 mm, respectively, and 0.79 mm and 1.1 mm, respectively, at three years (P <0.05).\textsuperscript{26}

Caiazzo et al reported on augmentation with the bone graft material placed in a soft-tissue pouch created on the external aspect of the buccal bone plate. This was found
to help preserve or increase the buccal bone plate width and reduce the risk of recession. In the anterior esthetic zone, a thin buccal bone plate results in soft-tissue recession and poor esthetic outcomes (Table 1).

 Appropriately selecting patients and following a strict protocol is important for preserving buccal bone plate dimensions. Buccal bone plates of at least 2 mm in width, atraumatic extraction, and palatal/lingual immediate implant placement have been found to minimize loss of buccal plate bone and the associated sequelae, as have ridge preservation and placement of bone grafting material around the gap between the implant and the osteotomy-extraction site. The Influence of Implant System Design on Short- and Long-term Results

Implant design, and that of adjunctive and restorative components, can influence the success of implant treatment both short- and long-term. Primary stability, osseointegration, esthetic and functional results, and the potential for peri-implantitis, can all be influenced by implant system design (Table 2).

Primary Stability

Primary stability requires excellent bone-to-implant contact at the time of implant placement and is essential to resist micromotion and for subsequent osseointegration. Factors influencing this include the bone density and quality, the morphology and surface characteristics of the implant, and surgical technique. Higher bone density favors greater primary stability, with the least dense bone typically found in the posterior maxilla. The surgical protocol must include use of matching-size bone drills for the implant being placed, with the diameter of the drill resulting in an osteotomy matching the minor diameter of the implant (ie, the diameter of the implant not including any threads or fins). Excessive removal of bone during creation of the osteotomy site must be avoided so that an intimate initial contact can be achieved between the implant surface and the adjacent bone. It has also been shown that a self-cutting implant design with lateral threads that enter the bone result in moderate compression of the bone adjacent to the osteotomy site, which may enhance primary implant stability prior to osseointegration.

Östman et al reported on a prospective clinical trial involving placement of 139 tapered implants with a microroughened topography and lateral threads. Their findings included a high degree of primary stability and a survival rate of 99.2%. The initial stability quotient (ISQ) was 73.3, more than the ISQ of 65 that is considered to be adequate for immediate loading of implants. In a separate study, immediate implant placement using the same implant design resulted in ISQs of 73 and 77 for the maxilla and mandible respectively.

<table>
<thead>
<tr>
<th>TABLE 1. Considerations Impacting Esthetics</th>
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<tr>
<td>Natural soft-tissue architecture</td>
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<td>Regeneration of papillae</td>
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<td>Suitable emergence profile for function and esthetics</td>
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<td>Adequate bone height, width and volume</td>
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<td>Position of bone at zenith</td>
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<td>Position of contact point</td>
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The results from these studies highlight the importance of careful patient selection and surgical protocol in achieving ideal esthetic outcomes and long-term success of implant treatment.
Osseointegration and Implant Surfaces

During the healing process, osseointegration results in long-term (secondary or biologic) stability, and involves the growth of bone onto the implant surface and particularly into rough implant surfaces.

The surface topographies of rough implant surfaces result in an increase in the surface area available for osseointegration, and are known to positively influence osseointegration and the precursors of bone growth. Such surfaces have also been shown to result in higher torque removal values and improved long-term stability, including at compromised sites, as compared to smooth surfaces. Designs in recent years have included: sand-blasted etched surfaces; oxidized surfaces; blasted and fluoride-etched surfaces; and surfaces with hydroxyapatite deposition.

One recent implant includes a hybrid design with a machine-turned implant neck and dual acid-etched over the body of the implant with micron-level etching superimposed on an etched surface. Another implant recently introduced has three different surface topographies including: sand-blasted etched surfaces; oxidized surfaces; blasted and fluoride-etched surfaces; and surfaces with hydroxyapatite deposition.

A recent randomized-controlled prospective study investigating 137 implants demonstrated the higher level of osseointegration and increased torque removal force in implants with a multi-topography surface roughened at the micron level. Baldi et al also found that these fully etched implants resulted in statistically significantly less crestal bone resorption than did implants with a turned neck surface (0.6 mm vs 1.5 mm).

Implant Surfaces and Peri-Implantitis

Historically, there have been concerns related to the incidence of peri-implantitis adjacent to rough-surface implants, where recession and bone loss around a smooth machined implant neck has resulted in exposure of the rough-surface implant body. However, recent studies on implants with more microscopically roughened surfaces found a different result. While minimally roughened (eg, etched) surfaces are biologically compatible, surfaces that are much rougher are more likely to be associated with peri-implantitis when exposed. A microscopically-roughened surface with additional pitting on the already roughened surface, obtained by dual-acid etching of the implant surface, and still with a smooth titanium neck, was found to result in less peri-implant tissue complications and to have survival rates of up to over 99%. Implants that are dual acid-etched and also fully etched at the neck of the implant have also been studied. A study published in 2009 (Baldi et al) reported on 1-year results of fully etched implants, finding reduced crestal bone loss as compared to implants with a smooth neck.

A prospective, randomized, controlled 5-year study evaluated the incidence of peri-implantitis in implants with a dual-acid-etched surface that were fully etched coronally and compared these to implants with a smooth coronal surface. No differences were found in the incidence of peri-implantitis, confirming that implant necks with a fully etched, microroughened topography are a safe and effective option.

Most recently, one implant design includes an implant neck with dual acid-etched surfaces over a minimally rough surface, while the more apical body of the implant includes coarser roughness as well and results in a triple-level surface. Studies have demonstrated that this design results in increased bone in-growth and greater torque removal force, while the fully etched neck is proven to reduce crestal bone loss.

The Implant-Abutment Interface

The design of the implant-abutment interface is a statistically significant factor in implant success rates. In a study assessing immediately loaded implants in premolar sites, buccal bone changes were observed with CBCT scans one year postoperatively, with more width loss at the level of the implant-abutment interface as compared to the mid-implant or the apical region of the implant. Horizontal buccal bone resorption was found to be greatest at the level of the
implant platform in a study assessing resorption at 1-year using CBCT scans, underscoring the importance of the platform and interface.

While historically implant-abutment interface designs were based on platforms with the same diameters, more recent studies have demonstrated that use of platforms of different diameters (platform-switching) results in preservation of crestal bone height levels and was also described in a recent systematic review of ten studies with 1,238 implants. The conclusion from this review was that platform-switching resulted in significantly less crestal bone loss than with platform-matched implants.

Thus, platform-switching designs now expressly incorporate abutments with a narrower diameter than the diameter of the implant at the implant-abutment interface. The successful use of platform-switching was shown to be statistically significant at the 1-year follow-up in one study and to result in a vertical bone loss of 0.01 mm vs 0.42 mm using a standard platform design (ie, without platform-switching). Platform-switching is believed to permit tissue-forming to occur inwards towards the implant and with a greater surface distance, resulting in a well-sealed biologic width between the oral environment and the peri-implant bone before crestal bone loss can occur.

Poorly sealed interfaces result in greater bacterial colonization, microleakage, and greater potential for peri-implantitis. A stable and tightly-engineered implant/abutment connection results in reduced micromotion and leakage. An implant-abutment connection with a positive seating design together with a connection with very narrow tolerances, results in avoidance of seating errors and an intimate, stable relationship between the implant and the abutment.

Immediate Provisionalization and Abutment Design

Immediate provisional restoration preserves the mucosal level and reduces the risk of midfacial recession. Following immediate implant placement, the emergence profile of the abutment used for the provisional restoration is critical — if too much pressure is placed on the peri-implant tissues and crestal bone, an increased level of bone resorption is observed, which in turn reduces the ability of the peri-implant tissue to increase in volume. Using a single-stage technique minimizes trauma, and immediate provisional restoration when performed properly provides for soft-tissue sculpting starting from the day of implant placement and results in excellent esthetics.

From the patient’s perspective, the ability to immediately provide an esthetic provisional restoration is an important factor in case acceptance and patient satisfaction, especially in the anterior esthetic zone. The case presented here demonstrates immediate implant placement with microroughened implants possessing three levels of surface roughness and built-in platform switching, for immediate implant placement and provisional restoration and the highly esthetic long-term results that are obtained.
Case Presentation – Immediate Implant Placement in the Anterior Esthetic Zone

The patient presented with failing central incisors, complaining of some mobility of one of the two crowns, bleeding at the gingival margin of one, and discomfort. On examination, the endodontically-treated central incisors were found to have unsalvageable restorations with caries extending below the bone level (Figs. 2a, 2b, 3). Following discussion with the patient, the decision was made to remove the central incisor roots and to place implant-supported restorations. The patient was concerned about not having teeth or having to wear a removable partial denture and was pleased to discover she was a candidate for immediate implant placement and provisional restoration. Bone sounding, together with an assessment of the patient’s biotype and bone adequacy including thickness of the buccal bone plate, were made. The patient’s biotype was favorable, both thick and with a flat profile, and sufficient width of buccal bone plate was present.

At the surgical appointment, flapless atraumatic extractions were performed, taking care to preserve all socket walls and the integrity of the buccal plate. The implants selected were 3i T3® Tapered Implants (BIOMET 3i) and have dual acid-etched microroughened collars, while the implant body has three levels of surface roughness consisting of a moderately rough surface, overlaid with 1-3 micron pitting on top of which a submicron layer exists, to enhance osseointegration and to help preserve crestal bone levels. The implants were 13 mm in length, with a 4 mm diameter and a 3.4 mm diameter restorative seating surface.

The osteotomy sites were prepared with the implant system’s matching-size drills, parallel to the palatal walls such that the osteotomies were more palatal than the original root positions. Depth/direction indicators were used to ascertain the depth and positioning of the implants that would be placed (Fig. 4). The implants were then placed in the osteotomy sites with achievement of excellent primary stability (Fig. 5), and bovine xenografts were placed in
the gap between the implants and the bone plates to aid bone regeneration (Fig. 6). The lateral threads of these implants aid primary stability, as does placing the implants more palatally. The relatively palatal placement also creates space for internal bone grafting against the buccal bone plate and helps to preserve adequate buccal bone width, without which mucosal recession would be likely. Xenografts are known to resorb more slowly than either autografts or allografts (in addition to avoiding the trauma and potential morbidity associated with autografts), and as such, provide for a more durable scaffold while bone regeneration takes place. Postoperative radiographs were taken of the implants.

Next, 3.4 mm diameter non-hexed provisional cylinders were inserted and screw-retained to the implants with abutment screws (Fig. 7). Platform-switching helps to preserve crestal bone levels and soft-tissue stability. The customized splinted provisional restorations were then placed over the cylinders, the heights of the cylinders were adjusted, the spaces between the cylinders and the provisional restorations were filled with resin material, and the provisional restorations were secured (Figs. 8, 9).

The patient returned four months later to her general dentist for placement of the definitive restorations. Tissue healing had been checked at the 2-week postoperative appointment and in the interim. The end result was a soft-tissue peri-implant architecture that was well-sculpted and would provide for a natural-looking appearance provided it was properly maintained (Fig. 10).

Composite resin was utilized to fabricate customized impression copings to record the soft-tissue profile (Fig. 11). After making the definitive impression, it was used to create a soft-tissue model that replicated the soft-tissue contours (Figs. 12-13).

At the time of restoration delivery, zirconia abutments were placed on the implants. Using abutments with a flat or parallel emergence profile (vs flared abutments) provides a contour that supports the soft tissue and optimizes esthetic results.\textsuperscript{66}
Figure 7. Provisional cylinders in position

Figure 8. Placement of provisional restoration

Figure 9. Post-operative view of completed provisional restoration

Figure 10. Peri-implant soft tissues

Figure 11. Placement of impression copings with composite resin added to maintain soft-tissue form during impression-making

Figure 12. Definitive impression with impression copings-composites picked-up in the impression
The abutment screw used with this implant design (Gold-Tite® Abutment Screw, BIOMET 3i) possesses a microscopic soft gold coating that behaves as a solid lubricant. This minimizes friction and allows for greater pre-load with the same amount of torque, increasing seal integrity. The definitive esthetic restorations were then cemented over the abutments (Figs. 13-14). The occlusion was checked to ensure that there were no occlusal interferences.

The end result was highly esthetic restorations with excellent emergence profiles, papillae and soft-tissue architecture, and a very satisfied patient (Fig. 15).

Summary
Using implants with microroughened surfaces, buccal bone grafts and platform-switching has been shown to aid osseointegration and the preservation of hard and soft peri-implant tissues. This results in excellent short- and long-term results with preservation of the crestal bone and soft-tissue architecture. The ability to provide patients with immediate implants and provisional restorations at the time of extraction has significantly expanded treatment options, shortened treatment times, provided for less-invasive treatment, and results in patient satisfaction.
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Acknowledgement

The case in this course was provided by Dr. Alan Meltzer and the definitive restorative care provided by Dr. Pamela Doray.
1. The first root-form endosseous implants were constructed of __________.
   a. machined titanium
   b. acid-etched titanium
   c. smooth-surface chromium
   d. none of the above

2. Systematic reviews have led to the conclusion that a mean horizontal bone loss (loss of ridge width) of __________ can be anticipated at extraction sites in the six months following tooth extraction.
   a. 1.8 mm
   b. 2.8 mm
   c. 3.8 mm
   d. 4.8 mm

3. Ridge preservation using mineralized particulate xenografts has been shown in some studies to reduce __________ bone loss at extraction sites.
   a. vertical and horizontal
   b. triagonal and vertical
   c. triagonal and horizontal
   d. vertical, horizontal and triagonal

4. In a study using bovine xenografts, a horizontal bone loss of on average __________ was found with the use of xenografts vs __________ for ungrafted sites at four months post-extraction.
   a. 0.4 mm; 3.48 mm
   b. 0.84 mm; 3.98 mm
   c. 1.04 mm; 4.48 mm
   d. none of the above

5. A __________ following implant placement can significantly compromise esthetics and result in dissatisfaction.
   a. moderate amount of soft-tissue recession or lack of a diastema
   b. minimal amount of soft-tissue recession or lack of a papillary structure
   c. moderate amount of soft-tissue recession or lack of a papillary structure
   d. none of the above

6. Östman et al assessed the 1-year cumulative survival and success rates for 102 immediately loaded, platform-switched implants supporting fixed prostheses, finding a cumulative survival rate of __________.
   a. 95.2%
   b. 97.2%
   c. 99.2%
   d. none of the above

7. __________ is an objective of immediate implant placement and restoration.
   a. Preservation of crestal bone and soft-tissue architecture
   b. Patient satisfaction
   c. Shorter and less invasive treatment
   d. all of the above

8. In a review of 19 studies, den Hartog et al found __________ for immediate, early and delayed loading protocols.
   a. a survival rate after one year of 95.5%
   b. statistically significant differences
   c. no statistically significant differences
   d. a and c

9. __________ is a risk factor for mucosal recession at the facial margin following implant placement.
   a. A thin biotype
   b. A thin or non-intact buccal bone plate
   c. Malpositioning of the implant
   d. all of the above

10. A self-cutting implant design with lateral threads may enhance __________.
    a. primary implant stability
    b. micromotion
    c. soft-tissue forming
    d. all of the above

11. If the distance from the contact point to the crest of the bone is __________, excellent papillary architecture is achievable.
    a. ≥5 mm
    b. ≤5 mm
    c. ≥5 mm
    d. ≤3 mm

12. Inadequate inter-implant space is a determinant for __________.
    a. increased crestal bone loss
    b. lack of papillary regeneration
    c. the type of interface
    d. a and b

13. An esthetic and natural-looking peri-implant soft-tissue architecture is more predictable and easier to achieve in patients with a __________.
    a. thick biotype and scalloped gingival contour
    b. thin biotype and scalloped gingival contour
    c. thick biotype and flat gingival contour
    d. thin biotype and flat gingival contour
CE QUIZ

14. ________ helps to minimize bone loss.
   a. A buccal bone plate of at least 2 mm width
   b. Atraumatic extraction
   c. Palatal/lingual implant placement
   d. all of the above

15. Ridge preservation and placement of bone grafting material around the gap between the implant and the osteotomy extraction site, have been found to minimize ________.
   a. change in soft-tissue morphology
   b. the required inter-implant distance
   c. peri-implantitis
   d. all of the above

16. Primary stability ________.
   a. requires excellent bone-to-implant contact at the time of implant placement
   b. helps resist micromotion
   c. helps with osseointegration
   d. all of the above

17. ________ influence(s) the achievement of primary stability.
   a. Surgical technique
   b. Bone density and quality
   c. Using drills that mimic the minor diameter of the implant
   d. all of the above

18. Implants with a fully etched implant neck were found by Baldi et al to ________ as compared to implants with a smooth neck.
   a. increase crestal bone loss
   b. reduce crestal bone loss
   c. have no impact
   d. none of the above

19. The surface topography of microscopically roughened surfaces results in an increase in the surface area available for ________.
   a. primary stability
   b. soft-tissue migration
   c. osseointegration
   d. none of the above

20. Xenografts resorb more slowly than ________.
   a. autografts
   b. allografts
   c. zinc oxide
   d. a and b

21. It has been found that coarse, rough implant body surfaces increase the likelihood of ________ if exposed.
   a. peri-implantitis
   b. fracture
   c. crestal bone preservation
   d. none of the above

22. Poorly sealed interfaces may result in ________.
   a. greater bacterial colonization
   b. microleakage
   c. greater potential for peri-implantitis
   d. all of the above

23. Platform-switched implant designs now expressly incorporate abutments with a ________ diameter than the diameter of the implant.
   a. wider
   b. narrower
   c. varying thickness
   d. any of the above

24. Immediate provisional restoration ________.
   a. may reduce the risk of midfacial recession
   b. may aid in the conservation of the mucosal level
   c. increases bacterial colonization
   d. a and b

25. A recent study found no differences in the incidence of ________, in comparing implant necks with a microroughened topography versus a smooth neck surface.
   a. osseointegration
   b. peri-implantitis
   c. satisfaction
   d. none of the above

26. In a study assessing immediately loaded implants in premolar sites, more buccal bone changes and width loss occurred at the ________.
   a. mid-implant region of the implant
   b. level of the implant-abutment interface
   c. apical region of the implant
   d. none of the above

27. Recent studies have demonstrated that the use of platforms of different diameters (platform-switching) results in preservation of ________.
   a. crestal bone height
   b. function
   c. microroughened surfaces
   d. none of the above

28. The emergence profile of the abutment used for the provisional restoration influences ________.
   a. the pressure placed on the peri-implant tissues
   b. the ability of the peri-implant tissue to increase in volume
   c. the level of bone resorption
   d. all of the above

29. Using an abutment with a flat or parallel design emergence profile ________.
   a. provides the best opportunity to maintain soft-tissue morphology
   b. reduces pressure on the facial soft tissue
   c. is ill-advised
   d. a and b

30. A high-integrity implant-abutment junction seal relies on ________.
   a. narrow tolerances
   b. an abutment screw design that helps to ensure excellent sealing
   c. the implant surface topography
   d. a and b
CE ANSWER FORM (E-mail address required for processing)

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EDUCATIONAL OBJECTIVES

- Describe the rationale for immediate implant placement and restoration
- Review the survival and success rates of immediate implant placement
- List and describe the factors involved in achieving excellent results in the anterior esthetic zone
- Review the influence of implant design and adjunctive restorative and surgical components on short- and long-term functional and esthetic success

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