

Esthetic Failure in Implant Dentistry



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KEYWORDS

- Esthetic zone • Dental implants • Esthetic failure • Patient satisfaction
- Prosthodontically driven implant placement • PES/WES

KEY POINTS

- In today's dentistry, it is not enough to simply assess the clinical parameters of a dental implant restoration in the rehabilitation of missing teeth.
- Although the dental literature contains information about esthetic failure in general dentistry, no clear consensus is available regarding esthetic failure of dental implants.
- Both objective and subjective parameters are important in determining the esthetic success or failure of an implant-supported crown.
- On the basis of objective indices, esthetic failures in implant dentistry can be categorized as pink-tissue failures and white-tissue failures.
- Pink-tissue failures are more common; they include facial recession, gingival asymmetry, papillary deficiency, and graying of the gingival tissue.

Osseointegrated endosseous dental implants have been deemed an innocuous and predictable form of rehabilitation that can be used to replace dentition in patients who are completely or partially edentulous and those who are missing only a single tooth. The average survival rate of multiple-implant designs is higher than 90%.¹⁻³ The success rate of such implants has also been evaluated, although various criteria have been used and these have changed over time.⁴ The criteria for implant success in 1979 permitted 1 mm or less of mobility with some radiographic radiolucency and bone loss, whereas it currently includes absence of mobility, absence of radiographic radiolucency, and minimal bone loss.^{5,6}

Even though the parameters of success have evolved, the early concern in implant dentistry was primarily osseointegration, and even today, osseointegration remains the predominant parameter of success in implant dentistry. However, because of

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patient and clinician demands and the increased certainty of osseointegration, new parameters are now being used to assess implant success. Some examples of these parameters are peri-implant soft-tissue level, prosthesis level, and patient's subjective assessments; these parameters should be considered by dentists in evaluating the success or failure of implant dentistry. The focus is shifting from implant survival to the creation of lifelike implant restorations with natural-looking peri-implant soft tissues.⁴ Patients today have a high demand for esthetics and want not only improved function but also normal appearance.⁷

Esthetics plays an important role in any implant placement but is crucial for implants placed in the anterior maxilla. An anterior single implant-supported crown restoration must meet a particularly high standard of esthetic quality because the adjacent natural teeth provide an immediate comparison to the crown.⁸ Overall, implant dentistry in the esthetic zone is challenging because the implant restoration and surrounding tissues will be visible when the patient smiles fully and because it will be placed in an area of esthetic importance for the patient.⁹ According to the Straightforward, Advanced, and Complex International Team for Implantology (ITI) classification, any implant in the esthetic zone must be classified as either advanced or complex, a classification deriving from the technique sensitivity required for replacing missing teeth in the anterior maxilla.¹⁰

Patients' and clinicians' high demands and expectations for esthetics have expanded the criteria for the success of implants from osseointegration alone to a harmonious and natural blending of the restoration with the surrounding tissues and dentition.¹¹ Higginbottom and colleagues⁹ defined an esthetic implant restoration as one that resembles a natural tooth in all aspects. Acknowledging that patients and clinicians consider the esthetics of an implant very important, it should be determined when an implant is considered a failure from an esthetic point of view.

Although the dental literature contains information about esthetic failure in general dentistry, to the authors' knowledge, no clear consensus is available regarding esthetic failure of dental implants. Late in the 1990s, el Askary and colleagues¹² defined an implant failure as failure of the implant to fulfill its purpose (functional, esthetic, or phonetic). However, the only types of failures associated by the authors were absence of osseointegration, prosthetic fracture, gingival bleeding, and infection. Furthermore, until recently an implant was considered a failure when it was lost, fractured, or mobile, or a source of irreversible pain or infection.¹³ In summary, the word failure as applied to dental implants is frequently used in the dental literature to indicate the loss of osseointegration; it has seldom been used to describe a lack of esthetic success. In fact, the word complication is often used when a problem occurs with any of the replaceable components of the implant system.^{12,14}

Most dictionaries define failure as "lack of success." If this definition is extrapolated to esthetics and dental implants, esthetic failure in implant dentistry would refer to a lack of success in achieving esthetics with dental implant restorations. Consequently, success in implant dentistry needs to be redefined.

The dental literature demonstrates the lack of a consensus about the parameters used to determine esthetic success or esthetic failure in implant dentistry. As mentioned, some authors apparently do not consider these parameters important, because they consider only osseointegration when evaluating the success of their treatments.¹³ Other authors report esthetic failures but fail to provide adequate information about how these failures were evaluated.¹⁵ Henry and colleagues¹⁶ reported an esthetic failure rate of 10% in a 5-year multicenter study; nevertheless, the authors did not report the parameters used to determine the cause of these esthetic failures. Similarly, Goodacre and colleagues¹⁷ did not describe poor esthetic outcomes as

failures but rather as esthetic complications. As examples of such complications, they reported improper restoration contour, poor shade, and exposure of implant components because of gingival recession.

Esthetics refers to the response of the mind and the emotions to beauty. As Lew Wallace wrote, "Beauty is altogether in the eye of the beholder." Two important factors influence this concept in dentistry: the patient and the clinician. Esthetics is a subjective perception that varies from individual to individual and is also influenced by socio-cultural values.¹⁸ Chang and colleagues⁸ demonstrated that the appreciation of esthetic outcomes is higher among patients than among prosthodontists. They indicated that the factors considered by clinicians to be important for an acceptable esthetic result of restorative therapy may not be imperative for patient satisfaction. Dueled and colleagues,¹⁹ on the other hand, found a positive linear correlation between professional and patient evaluations of esthetic outcomes, but this correlation was not statistically significant. In most studies, patients were more satisfied with the overall outcome than was the professional examiner.²⁰⁻²²

OBJECTIVE ESTHETIC INDICES

The dental literature has described several systems for evaluating esthetic outcomes of implant restorations in the esthetic zone.

In 1997, Jemt²³ proposed an index to assess the size of the interproximal gingival papillae adjacent to single implant restorations. This index has been used in several studies evaluating esthetics in dental implant dentistry because it was one of the first to consider the papilla in relation to implant restorations.^{19,24,25} Jemt's Papilla Index (JPI) categorizes the presence of interdental papilla on a scale ranging from 0 to 4, assigning a rating of 0 for no papillae and a rating of 4 for hyperplastic papillae. However, the JPI does not consider the entire contour of the soft tissue around the implant.²³

Fürhauser and colleagues²⁶ developed the pink esthetic score (PES) for evaluating the soft tissue around single-tooth implant crowns. They objectively assessed the esthetic outcome of the soft tissues contouring a dental implant restoration, addressing crucial problems that are easily overlooked in a general assessment. The PES criteria are based on 7 variables: mesial papilla, distal papilla, soft-tissue level, soft-tissue contour, alveolar process deficiency, soft-tissue color, and texture. Each variable is given a score of 2, 1, or 0 with 2 as the best score and 0 as the worst score, for a maximal possible score of 14. All variables except papilla are assessed by comparison with a reference tooth. The PES index not only includes more variables than the JPI but also evaluates the height, level, color, and texture of the peri-implant soft tissues. Others have used this index successfully²⁷⁻³² and have indicated that the appearance of the peri-implant soft tissue and the dental restoration is the "difference maker" between a successful and an unsuccessful outcome.²⁷

Evans and Chen²⁴ developed the subjective esthetic score (SES) as a complement to the JPI. Their objective was to rate the esthetic outcome of immediate implant placement on the basis of the vertical change in the position of the mucosal margin and the fullness of tissue after the restoration. The SES has proved to be a good complement to the JPI because it assesses the soft tissue surrounding the implant restoration as a whole. Furthermore, this index is useful in evaluations of esthetics because it assesses gingival recession after implant placement.

Meijer and colleagues³³ developed the Implant Crown Aesthetic index as an objective index for rating the esthetic outcomes of implant-supported single crowns and adjacent soft tissues. They rated 9 variables, 5 related to the crown (mesiodistal dimension, position of the incisal edge, labial convexity, color/translucency, and

surface) and 4 relating to the surrounding soft tissue (position of the labial margin of the peri-implant mucosa, position of the mucosa in the approximal embrasures, contour of the labial surface of the mucosa/color, and surface of the labial mucosa). This index considers the adjacent and contralateral teeth as a reference and scores the esthetics of the restoration on a scale ranging from 0 to 5: 0, excellent; 1 to 2, satisfactory; 3 to 4, moderate; and 5 poor. This index was an improvement because it incorporated variables relating to both the surrounding soft tissues and the hard-tissue restorations in the determination of esthetic outcomes. Other authors have used this index successfully.³⁴

Dueled and colleagues¹⁹ developed an objective scoring system for evaluating the esthetic outcomes of oral rehabilitation for patients with tooth agenesis. Their score incorporates mucosal discoloration, crown morphology, crown color match, and symmetry/harmony. It also evaluates the level of the papilla by using a modified JPI. Each variable is assessed with a score ranging from 1 to 4, with 1 as the optimal score and 4 as the poorest.

Belser and colleagues³⁵ developed an objective comprehensive esthetic index that incorporates the PES with a white esthetic score (PES/WES). The authors' objective was to develop an index that evaluates the relevant peri-implant soft tissues and specifically evaluates the parameters inherent to the restoration. The index is easy to use and reproducible, and it can be used in research and in clinical practice. The authors modified Fürhauser's PES by decreasing the number of variables from 7 to 5: mesial papilla, distal papilla, curvature of the facial mucosa, level of the facial mucosa, and root convexity/soft tissue color and texture at the facial aspect of the implant site. All variables except the papilla are assessed by comparison with a reference tooth. Each variable is rated on a 2-1-0 scale, with 2 as the best score and 0 as the poorest; this rating results in a maximal possible score of 10. The authors set the threshold of clinical acceptability at 6. The WES focuses on the visible part of the implant restoration and is based on 5 variables: general tooth form, outline/volume of the clinical crown, color (hue/value), surface texture, and translucency/characterization. Each variable is rated on the same 2-1-0 scale, for a maximal possible score of 10. Again, the authors set the threshold of clinical acceptance at 6. When the PES and the WES are combined, the maximal score is 20, which indicates that the peri-implant soft tissues and the clinical single-tooth implant crown are a close match for the contralateral natural tooth. The authors arbitrarily set the clinically acceptability at 60%.

The PES/WES index was the first attempt at determining esthetic failure. It can be inferred that any score lower than 6 on either scale or lower than 12 on the combined index can be assessed as an esthetic failure. Although a score higher than 6 or 12 implies an esthetic success, acceptability should be based on a score of 6 for each scale separately and not on a combined score of 12. A dental implant restoration should be considered a failure (or deemed unacceptable) if the score on either index is lower than 6. Of all available indices, the PES/WES index has been the most widely used and accepted by the research community for evaluating the esthetic outcomes of various implant placement and restorative techniques.^{29–31,34,36–44}

Cosyn and colleagues^{29–31} used Fürhauser's PES with 7 parameters. Each parameter is assessed with a 2-1-0 scale. The authors set the threshold for clinical acceptance at a score of 8 of the possible total of 14 points; they considered a score of 12 or higher to be (almost) perfect and a score lower than 8 to be a failure. They also used the WES, maintaining Belser's requirement of a score of 6 or higher for clinical acceptability and establishing a new threshold score of 9 or higher for results considered (almost) perfect. Cosyn determined that a WES lower than 6 represented

an esthetic failure and evaluated each case for metal exposure. To the authors' knowledge, Cosyn and colleagues are the only authors to have clearly reported an objective value for an esthetic failure.

PATIENTS' SUBJECTIVE EVALUATIONS OF SATISFACTION WITH ESTHETICS

In today's dentistry, it is not enough to simply assess the clinical parameters of a dental implant restoration in the rehabilitation of missing teeth. Patient-reported outcome measures (PROMs) have become a relevant method of establishing the impact of implant dentistry on the patient's quality of life.⁴⁵ In 2006, Marshall and colleagues⁴⁶ reported the necessity of shifting into a patient-based health care model in which patient-reported assessments provide useful feedback that can assist clinicians in improving the quality of care. In 1989, Smith and Zarb⁴⁷ stated that, if an oral implant rehabilitation is to be considered a success, both the clinician and the patient should find the esthetics of the restoration acceptable. Although patient satisfaction is very important, it is difficult to assess because of its subjective and multifactorial nature. Patient satisfaction is related to many aspects of PROMs in implant dentistry, including increase in quality of life, mastication capabilities, economics, and esthetic satisfaction.⁴⁸ Although many of these aspects have been studied in relation to implant dentistry, evidence about the esthetic aspect of patient satisfaction is not only sparse but also widely diverse; no index and no agreed-on methods for measuring patient-reported esthetic success have been published in the dental literature.^{49,50}

The current need for considering the patient's viewpoint in measures of treatment outcome has led many authors to incorporate patient-reported satisfaction within their outcome evaluations.^{8,15,21,22,30,31,51,52} Patient satisfaction is influenced by many variables: confidence when smiling, comfort when chewing or biting, speaking well, and value for the price.²² Most authors have found that patients are very satisfied with their esthetic outcomes, with 80% or more of the patients surveyed reporting satisfaction.^{8,22,51,53} Most authors have also found poor correlations between professional esthetic evaluations and patient-reported esthetic outcomes.^{8,19,22,30,52} Cosyn and colleagues³⁰ found no statistically significant correlation between objective PES and WES ratings and the patient's esthetic satisfaction as determined by a visual analog scale. Mazurat and Mazurat⁵⁴ indicated that the best way to improve patient satisfaction is to have a patient who is well informed and therefore has realistic expectations.

Much effort has gone into obtaining objective ratings of the esthetic outcome of an implant-supported single-tooth restoration, and the PES/WES index has proved to be a most useful tool in this regard. However, as clinicians, we must now find a way to combine the objectivity of the PES/WES index and the subjectivity of patient-reported esthetic satisfaction with the outcome. Only with such a combination can an index be created that will allow the inclusion of patient satisfaction in the evaluation of the success or failure of a restoration. In the meantime, esthetic failures in implant dentistry can be categorized on the basis of objective criteria. It is essential to recognize the causes of factors affecting these results and the possible treatment and prevention of these failures so that predictable peri-implant esthetic outcomes and patient satisfaction can be obtained.

The 2004 Consensus Statement of the ITI regarding esthetics indicated that objectively the esthetic zone is any dentoalveolar segment that is visible when the patient is fully smiling.⁵⁵ This muscular action around the lips is associated with brightening of the eyes and is one of the most important aspects of nonverbal communication. The smile line, which defines the esthetic zone, focuses on the position of the upper

lip and falls into 1 of 3 categories⁵⁶: a high smile (29% of the population), which reveals the total cervical incisal length of the maxillary anterior teeth and contiguous gingiva; an average smile (56% of the population), which reveals only 75%–100% of the maxillary anterior teeth and the interproximal gingiva; and a low smile (15% of the population), which reveals less than 75% of the anterior teeth. For prosthodontists, a high smile is challenging because it exposes the gingiva, and any soft-tissue deficiency will be highlighted. Even a low smile can be a challenge with a demanding patient. Therefore, the clinician should carefully inform the patient about the risks and possible outcomes of any planned procedure.

OBJECTIVE FAILURES IN IMPLANT DENTISTRY

On the basis of objective indices, esthetic failures in implant dentistry can be categorized as pink-tissue failures and white-tissue failures. The most frequently reported pink-tissue failures are facial recession, gingival asymmetry, papillary deficiency, and graying of the gingival tissue.

Pink-Tissue Failures: Factors, Prevention, and Treatment

Pink-tissue complications within the esthetic zone can be caused by various errors committed before, during, or after the placement of implant. Several factors can lead to these failures, but the incidence of these factors can be substantially reduced by proper implant spacing, cautious timing of site preparation, and careful implant placement.⁵⁷

Implant position

The 3-dimensional positioning of a dental implant is a key factor in achieving an adequate esthetic result. The position of the implant dictates the emergence profile of the tooth to be replaced; for this reason, implants should be positioned properly in all 3 spatial directions. Furthermore, achieving a long-lasting esthetic outcome requires using the final restoration as the guide for implant placement and considering the form and position of the planned prosthesis for final restoration.^{58–60} Over the past decade, advances in implant dentistry have helped create a greater appreciation for the esthetic demands of the clinician and the patient.⁶¹ Because of these demands, implant dentistry has experienced a profound shift: from function, with a surgically driven approach, to esthetics, with a prosthetically and biologically driven approach.⁶² In nature, what looks good usually works well. Applying this same premise to implant dentistry will allow a treatment outcome that balances esthetics with function.

The ideal positioning of an implant in all 3 dimensions, regardless of the implant system used, has been well described in the dental literature. Published reports have also described zones of comfort and danger in the placement of an implant in the esthetic zone.⁶³ Mesiodistally, the danger zones are located next to adjacent teeth. The facial danger zone is located anywhere facially to the imaginary line highlighted from the point of emergence of the adjacent teeth. The palatal danger zone begins 2 mm from the point of emergence and is associated with an increased risk of ridge-lap restoration.⁶³ Several guidelines have been suggested for optimizing esthetic results in implant placement. First, the position of the implant depends on the planned restoration that the implant will support. Second, the implant platform should be located 3 mm apical to the zeniths of the predetermined facial-gingival margins of the planned restorations. Third, the center of the implant should be placed at least 3 mm palatal to the anticipated facial margins. The objective is to avoid poor facial bone thickness and gingival recession. Special consideration should be given to the thin gingival biotype; in such cases, it may be necessary to place the body and shoulder of the implant

slightly more palatally to mask any show-through of titanium.⁶³ Fourth, an interimplant spacing of 3 mm is required between adjacent implant platforms. A decrease in this spacing can cause resorption of the interproximal alveolar crest and a reduction in papillary height. Fifth, the implants should emerge through the palatal incisal edge of the ensuing crown positions.⁶²

The risk of esthetic failure is higher when implants are placed “free hand,” without surgical guides.^{59,64} Reverse planning, starting from the final tooth position, allows determination of the exact location of the implant and assures an esthetic outcome. Careful planning and the use of a wax-up, a mock-up, and surgical guides will provide the surgeon with references for locating the implant properly in the 3 directions of the space: apico-occlusal, mesio-distal, and labio-palatal. In this manner, an esthetic result can be achieved. However, fabricating a guide from a wax-up is associated with certain limitations. If the planned position does not match the available bone, the clinician has few options for making small changes. The recent development of virtual restorative planning is promising, because it combines the ideal prosthetic position with the availability of bone. Computer technologies, applied with knowledge, make esthetic complications unlikely and provide optimal function and appearance.^{65,66}

The failures that result from improper implant placement are many and can lead to all of the above-mentioned pink-tissue failures. Nevertheless, these failures can be avoided by thorough treatment planning, careful site development, the use of surgical guides, and a proper understanding of restorative aspects when the implant is placed.⁶⁰

Multiple edentulous space replacement

When 2 anterior adjacent teeth are missing, the dental literature agrees that 2 implants should be placed if enough space is available (**Fig. 1**). However, when they are replacing multiple teeth, adjacent implants could compromise the interimplant crestal bone, resulting in resorption and soft-tissue loss. Maintaining or creating a proximal papilla between 2 implants is one of the most challenging aspects of such a procedure. Interimplant spacing of 3 mm is required between adjacent implant platforms so that interimplant bone and soft tissues can be preserved.^{62,67,68} A distance of 5 mm or less from the base of the proximal contact to the crest of the bone is recommended for assuring the presence of a proximal papilla.⁶⁹ If a papillary deficiency is present when hard-tissue and soft-tissue augmentation procedures have failed, the restorative solution is to enlarge the proximal contact and locate it more apically, thereby allowing reduction of the cervical embrasure.⁷⁰

When 3 or more anterior teeth are missing, the underlying alveolar bone crest is normally flat, and the mucosal profile between adjacent implants tends to level.⁷¹ The consensus of the dental literature is that the fabrication of a fixed partial denture (FPD) with ovate pontics sculpting the intervening tissue may provide a better esthetic appearance than the placement of individual crowns. The placement of 2 implants and one pontic will create an illusion of papilla between an implant and an adjacent pontic (**Fig. 2**).^{9,60}

When lateral and central incisors are missing, the best treatment option may be to place 2 implants in the lateral incisor position and 2 ovate pontics in the central position.^{72,73} An excellent esthetic and functional result can be achieved by following the same principles as those followed when teeth are missing from canine to canine: the placement of 4 implants in the position of both canines and central incisors and the fabrication of 2 FPDs from the canine to the central incisor.

Timing of implant placement

The timing of postextraction implant placement is not an impediment to obtaining optimal esthetic results; however, various placement times generate different clinical

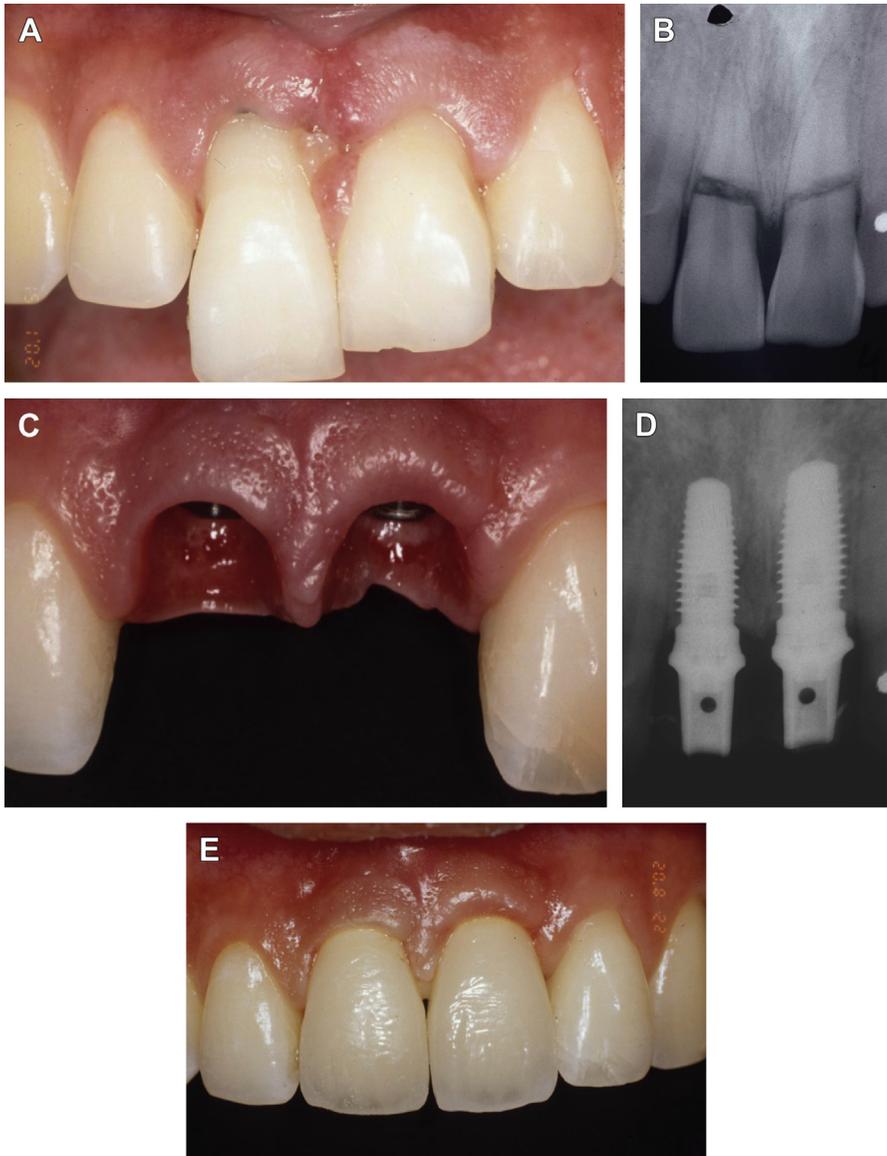


Fig. 1. (A, B) Clinical and radiographic root fractures at the cervical third of the roots. (C) Immediate implant placement. (D) Radiographic evaluation. (E) Final restoration with proper soft-tissue contours.

challenges that should be considered for optimizing the esthetic outcome.⁷⁴ Case reports have demonstrated that predictable esthetic outcomes can be attained with socket augmentation and immediate provisionalization of the implant.⁷⁵

Immediate implant placement and provisionalization can result in predictable outcomes, including the maintenance of soft-tissue esthetics^{76,77}; however, this procedure requires a high level of clinical competence.²⁴ Because it has been associated with great variability in outcomes,⁷⁸ the following clinical conditions must be met

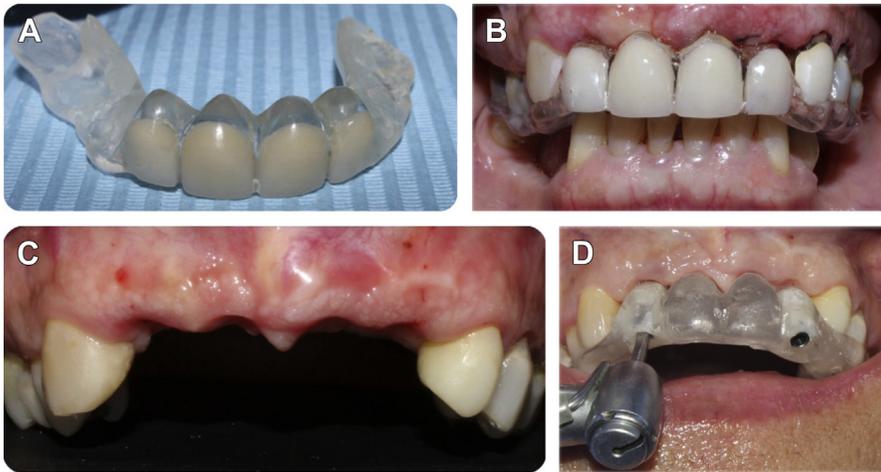


Fig. 2. (A) Interim removable partial denture with ovate pontics. (B) Interim removable partial denture with ovate pontic for sculpting the tissue and developing the illusion of a papilla between an implant and an adjacent pontic and between pontics. (C) Soft-tissue result after ovate pontic remodeling. (D) Implant placement in the area of the lateral incisors for a future FPD design using a surgical guide.

to ensure a good outcome: a facial bone wall at least 1 mm thick, a thick gingival biotype, and enough available bone to provide primary stability. If these conditions are not met, early or delayed implant placement should be considered.⁷⁴ Belser and colleagues³⁵ demonstrated that early implant placement for anterior maxillary single-tooth replacement is also a predictable treatment modality from an esthetic point of view. Furthermore, the outcomes of early and delayed placement of single implants in the anterior maxilla are comparable in terms of clinical response, soft-tissue appearance, and patient satisfaction.^{30,79}

Although promising results are feasible for immediate, early, and delayed single implants in the esthetic zone, the question of which of these treatment methods would result in better treatment outcomes has not yet been definitively answered because of the lack of well-designed controlled clinical studies.⁵⁰

The immediate placement of an implant in a fresh extraction socket in the anterior maxilla with no incisions or flap elevation is a surgical option that can ensure ideal healing of peri-implant tissues and can preserve the presurgical aspects of gingiva and bone (see **Fig. 1**; **Fig. 3**).^{77,80} In delayed implantation, a flapless protocol may provide a better short-term esthetic result, although there appears to be no long-term advantage.⁸¹

Soft-tissue management

Soft tissue is of fundamental importance for esthetics, and the esthetics of a well-placed implant can be poor if the soft tissue is improperly managed. Soft tissue should be considered at the earliest stages of implant planning, before tooth extraction if possible.⁶⁰ Soft-tissue contours are influenced by the presence and the position of the bony anatomy. As with natural teeth, with implants the concept of biological width dictates that peri-implant soft tissues should consistently be approximately 3 mm thick around the implant and even thicker in interproximal areas. This thickness should be considered when an implant is placed, because the bone position will determine the soft-tissue position.⁶³

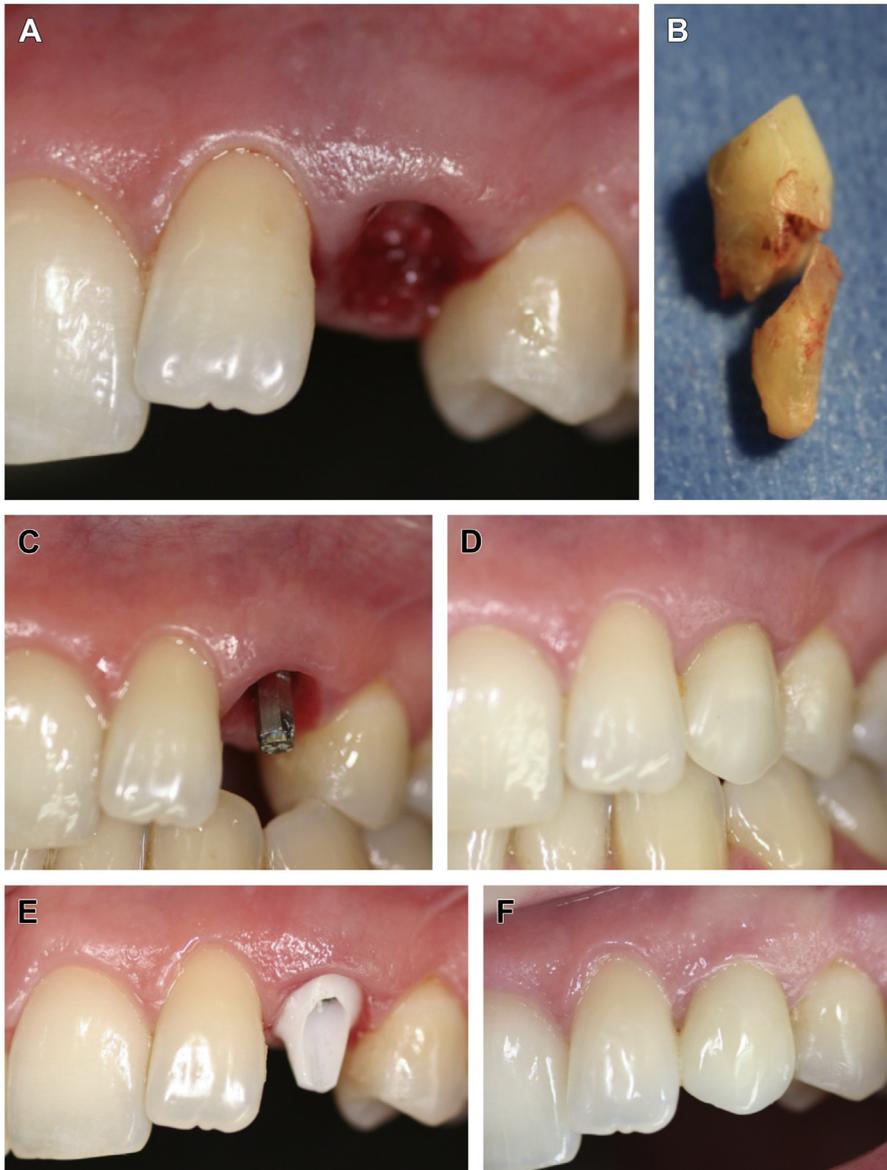


Fig. 3. (A, B) Atraumatic extraction. (C, D) Interim abutment and temporary crown forming the emergence profile. (E, F) All-ceramic abutment; final restoration with proper gingival contours.

The gingival biotype must also be considered when the goal is optimal esthetics. A thick biotype is considered favorable, especially with regard to gingival recession, the most common esthetic complication associated with dental implants.⁸² A thin biotype with reduced tissue thickness and scalloped gingival architecture is the least favorable for consideration of esthetics. This biotype may require modifications of the gingival biotype, such as connective tissue grafting.⁸³ Care should be taken during these procedures to minimize the lack of blood supply, for instance, with flapless surgery.⁸⁴

Establishing a soft-tissue contour with intact papillae is the most difficult factor in achieving an optimal esthetic result. The interproximal crestal bone level seems to be the primary factor in the presence of peri-implant papilla.⁷⁰ Studies have demonstrated that maintaining a distance of no more than 6 mm from the contact point to the alveolar crest neighboring the implant is necessary to obtain an intact papilla.⁶³ On the other hand, when an implant is replacing a single tooth, the peri-implant papilla is dependent not on the proximal bone next to the implant but instead on the bone level of the adjacent tooth.⁸⁵ Techniques for addressing a missing papilla because of the lack of vertical bone are very difficult to perform. One such technique is the orthodontic extrusion of natural teeth.⁷⁰ Other techniques have been proposed, but none of them are reasonably predictable.⁸⁶ The height and thickness of facial bone are important for long-term harmonious gingival margins. Therefore, the quality and quantity of facial bone should be considered before an implant is placed. An implant placed in an area containing a facial bone defect will lead to gingival recession. Various surgical techniques are available for overcoming facial bony defects, including onlay grafting, guided bone regeneration, a combination of block bone grafts and barrier membranes, and distraction osteogenesis (Fig. 4).⁶³

A common pink-tissue failure is gingival asymmetry. Some options for correcting this failure are orthodontic movement and/or crown lengthening of the teeth in the esthetic zone. Orthodontic movement should be slow, and natural teeth in the esthetic zone can move vertically. This movement causes the soft and hard tissues to move in unison with the tooth being modified orthodontically. This technique can be complemented by periodontal plastic procedures such as crown lengthening. These options re-create the tissue architecture by modifying the position of the teeth and blending the soft tissues with the implant restoration within the esthetic zone.⁸⁷

Careful and, as much as possible, a low-traumatic soft-tissue handling is essential for obtaining natural-looking results.⁶³ Mismanagement of the soft tissue often results in esthetically unacceptable restorations, and such situations are difficult to correct. An important step in decreasing scarring in the soft-tissue topography around the implant is making the incisions exclusively on the attached gingiva.⁸⁸ Transposing the palatal keratinized tissues labially also enhances the emergence contour (Fig. 5).⁸⁹

The basic principles of reflecting the flap, handling the tissues, and closing the wound should be considered so that esthetic failures can be prevented. Many options for reconstructing the interdental papilla have been proposed, but none of them provide reasonable predictability.⁸⁶

Hard-tissue management

In the past, the amount of available bone often dictated the placement of implants. Today, bone augmentation procedures are used to align the bone and to permit the precise placement of the dental implant, according to previous prosthetic planning (see Fig. 2C).

Advances in manufacturing bone substitutes and increases in knowledge about guided tissue regeneration procedures have made bone-grafting techniques more predictable and, therefore, have made implant placement prosthetically driven. On the other hand, advanced reconstructive surgery increases the risk of complications and compromised esthetics. Therefore, efforts have been made to avoid complex therapy by performing minimally invasive treatment of bone defects.³¹

Implant design (diameter)

Improper implant selection can also lead to esthetic failure. Initially, it was recommended that the size of the implant to replace a missing tooth should be similar to the

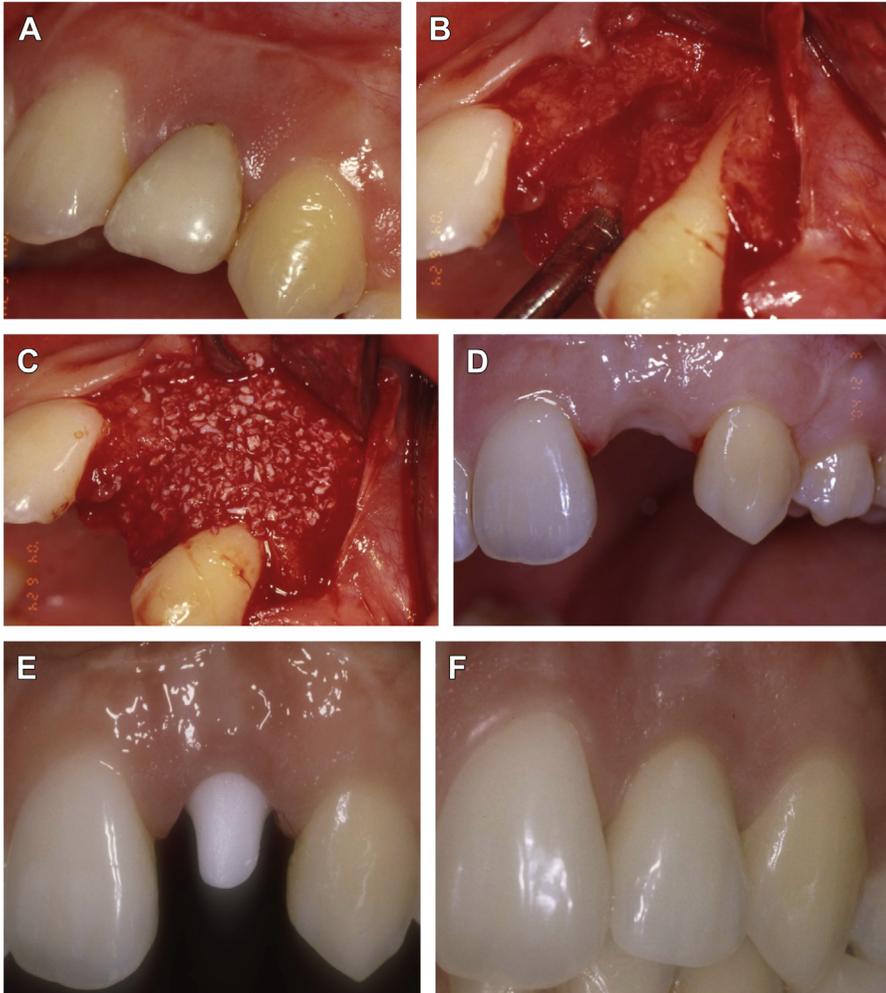


Fig. 4. (A) Preoperative view. (B) Facial bony defect. (C) Guided bone regeneration. (D) After reconstruction result. (E) All ceramic abutment. (F) Final restoration with proper soft-tissue contours.

diameter of the missing tooth at the bony crest. These wide-necked implants lead to less available bone on the facial aspect of the implant and to the esthetic failures described above. When multiple implants are placed, these wide-necked implants decrease the amount of bone between the implants and lead to bone resorption. However, in the past decade, emphasis has been placed on avoiding oversized implants in an effort to optimize esthetic results in the anterior maxilla.⁶³ Maintaining a generous amount of facial bone by using implants less than 4 mm in diameter appears to be beneficial for esthetics.⁹⁰

Prosthetic considerations

Because the final restoration is the ultimate objective of implant procedures, implant position should always be considered from the perspective of achieving the optimal

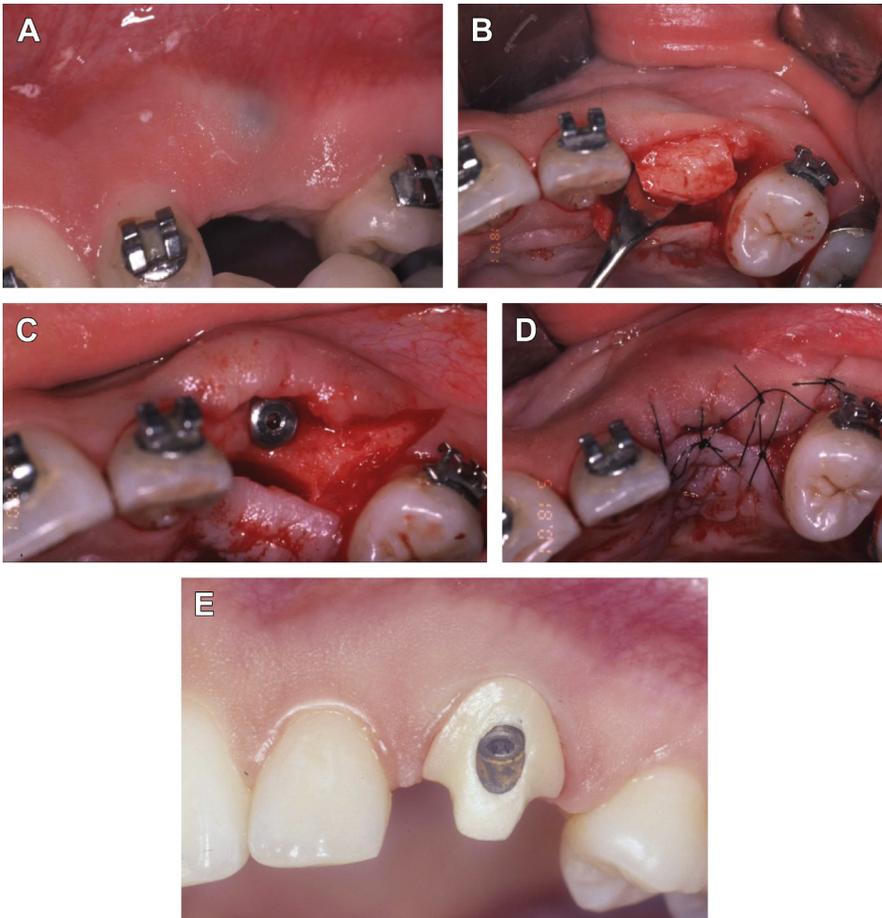


Fig. 5. (A) Implant in poor position, angled labially and exiting the ridge too coronally; thin gingival biotype. (B, C) Transposing the palatine keratinized tissues labially. (D) Closing the flap. (E) Final result of soft-tissue management.

restoration. After implant placement, many factors may affect the restorative phase, beginning with the healing abutment and the provisional restoration, which create the first gingival contour, followed by the abutment connection, the abutment diameter, and the shape and color of the final restoration. The abutment connection is important: an abutment connection in which the abutment is narrower than the implant offers distinct advantages, most notably less bone loss.⁹⁰

The provisional stage of the treatment is another important factor that influences esthetics. It has been suggested that provisional restoration should be immediately inserted after implant fixation to guide the healing of gingival tissues with a proper emergence profile. This procedure also provides the patient with psychological comfort because the immediate esthetic reestablishment will be beneficial.^{58,90,91} When implant placement is delayed, an emergence profile should be created by gradually increasing the cervical diameter of the provisional restoration until the expected soft gingival contour has been achieved. After the correct emergence profile has been

created or maintained with the provisional implant restoration, the position of the soft tissue must be transferred to the master cast for fabrication of the abutment and the restoration. This procedure can be performed with a customized impression coping that duplicates the emergence profile achieved with the provisional restoration. The shape of the definitive abutments and the definitive restoration will be identical to that of the provisional restoration, thereby maintaining the exact soft-tissue architecture, optimizing esthetics, and minimizing gingival discrepancies.⁹²

The restorative material of choice for the abutment and final crown could influence the color of the peri-implant soft tissues. Bressan and colleagues⁹³ determined that the color peri-implant tissues are different from that of the soft tissue around natural teeth regardless of the type of restorative material used. Jung and colleagues⁹⁴ associate this difference in color with the thickness of the soft tissues: when the tissues were more than 3 mm thick, no changes could be detected, but when they were 2 mm thick or less, the all-ceramic material exerted the least color change on the soft tissues. Therefore, when a thin biotype is present, a zirconia custom abutment with an all-ceramic crown should be the material of choice. Nevertheless, some patients still show color changes in the gingival tissues. In such cases, as a second option for masking these color changes when a thin biotype is present, some authors recommend staining the neck of the implant abutment with pink porcelain. This staining will minimize the change in the soft-tissue color.⁹⁵ A third option for a thin biotype is to undercontour the labial subgingival aspect of the abutment and, if necessary, the crown itself. This procedure allows space for the gingival tissue and maintains the soft-tissue contour. This concept is important for preserving the long-term stability of the soft tissue.^{96,97}

The advantages and disadvantages of cement-retained and screw-retained restorations have been thoroughly discussed in the dental literature. Esthetically, when the access to the screw channel is through the esthetic area, the screw option should be ruled out. The option of angled or custom abutment will correct the malpositioning of the implant, achieving a better esthetic result.^{98,99} One important factor regarding cemented restorations and esthetics is the difficulty of removing excess cement. Over the long term, the remaining cement may cause peri-implant inflammation and resorption of the peri-implant bone, leading to recession of the soft tissues and exerting a negative impact on esthetics.⁹⁹

When the reconstruction of ridge defects fails or the patient does not want to explore a surgical approach, nonsurgical management is possible. Ridge and soft-tissue deficiencies can be managed prosthetically with the use of gingiva-colored porcelain placed onto the cervical collars of customized abutments and the cervical aspect of the final restoration.¹⁰⁰

White-Tissue Failures

White-tissue failures are related to the general form of the tooth, the outline and volume of the clinical crown, color (hue and value), surface texture, and translucency and characterization. Butler and Kinzer¹⁰¹ indicated that the restorative failures are easier to correct than malpositioning problems. Solutions to these failures must be addressed individually on a case-by-case basis. Nevertheless, most of these failures depend on technique and are fortunately always reversible. For avoiding white-tissue failures, a team approach is highly recommended. This team should include a dental technician, preferably one who has advanced knowledge and clinical experience.⁶³

Several restorative materials can be used to restore an anterior implant. However, clinical reports¹⁰² and randomized clinical trials¹⁰³ regarding final implant restorations have confirmed that the material chosen for fabricating an implant crown does not in itself ensure an optimal esthetic outcome.

Independent of their type, many failures can be avoided by proper workup and treatment planning. Each of these aspects of treatment should be considered so that esthetic failures can be avoided and the desired natural-looking outcome can be achieved. Replacing missing teeth in the anterior maxilla is a challenge and involves all of the aspects thoroughly discussed in this article, but this procedure also holds an artistic aspect that should not be underestimated. This aspect is reflected in the words of Ralph Waldo Emerson: "Love of beauty is taste. The creation of beauty is art."

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