

# Extraction Defect: Assessment, Classification and Management

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**Abstract:** Tooth extraction is a traumatic procedure initiating a complex cascade of biochemical and histologic events that inevitably lead to a reduction of alveolar bone and soft tissue. These tissue alterations often lead to an esthetic compromise of the future implant restoration. The hard- and soft-tissue architecture surrounding the extraction defect largely dictates the course of dental implant treatment. The EDS or extraction defect sounding classification is a novel system introduced to simplify the decision-making process when planning for dental implant therapy following tooth extraction. Dental implant treatment guidelines-based on the EDS classification are discussed. A review of pretreatment evaluations necessary to prepare for esthetic implant procedures is also presented.

**Keywords:** Extractions, classification, hard tissue deficiency, soft tissue architecture.

## INTRODUCTION

Tooth extraction is a traumatic procedure often resulting in immediate destruction and loss of alveolar bone and surrounding soft-tissues. A complex cascade of biochemical and histologic events then ensues during the wound healing process which further leads to physiologic alterations to alveolar bone and soft-tissue architecture.<sup>1-3</sup>

The morphologic changes seen following tooth extraction can easily be reduced through current site preservation techniques. Atraumatic extraction techniques using microsurgical instrumentation including periostomes or similar devices, the use of hard-tissue graft materials derived from a variety of sources, graft-stabilizing membranes, as well as soft-tissue grafts can reduce the degree of damage and extent of resorption that physiologically occurs following tooth extraction.<sup>4,5</sup> The extraction socket with an undamaged alveolus and well-preserved soft tissues can be successfully treated with immediate implant placement.<sup>6</sup> When the hard- and soft-tissue architecture of the extraction defect is moderately to severely compromised, site preservation often in conjunction with site development procedures is commonly necessary.<sup>7</sup>

The clinical presentation of alveolar defects seen immediately following tooth removal varies from simple to

complex. This evaluation can only be accurately made immediately following extraction, since damage often occurs during the process of tooth removal and the periodontal attachment commonly shrouds hard-tissue architecture. A classification of the extraction defect, as it presents immediately following tooth removal associated with dental implant treatment recommendations, would be beneficial for the clinician in establishing the most appropriate plan for treatment. The purpose of this paper is to present a novel extraction-defect classification system which categorizes extraction defects and provides clinical guidelines for dental implant treatment.

## PRETREATMENT EVALUATION

### Medical History

A careful patient medical evaluation is paramount to the success of dental implant procedures. A thorough medical questionnaire and interview is necessary in order to assess and anticipate the patient's general healing potential and uncover possible systemic anomalies which could potentially compromise the procedural outcome. Factors that could compromise wound healing should be identified and documented. The most common include smoking, poorly controlled diabetes, impaired liver function, drug or alcohol abuse, long-term corticosteroid use, and extreme age.<sup>8,9</sup> Diminished regenerative outcomes may be expected with medically compromised patients and surgical procedures modified to accommodate for these deficiencies. These modifications may include planning a more conservative implant treatment sequence, using autogenous bone over other biomaterials when needed, placing interpositional connective tissue grafts in order to pre-empt recession, and increasing the healing times.

### Dental History

A detailed dental history and thorough understanding of the pathology leading to the extraction is vital to the assessment and management of the extraction defect. Teeth with a history of endodontic pathology, apical surgery, trauma or advanced

periodontal disease may impart a site with an inherent compromise in wound healing.<sup>10</sup> Teeth with a history of fistula, apical surgery, or deep periodontal pockets may present with missing bony walls following their removal, which may limit the regenerative outcomes. These factors, when well-understood, will influence the type of materials selected and procedures performed. For example, when socket walls are missing, membranes may be necessary to guide tissues and stabilize graft material. When the surrounding tissues are anticipated to have a compromised healing response, osteogenic grafts such as autogenous bone may be preferable over other graft materials.

### Esthetic Evaluation

Prior to tooth removal, a dentogingival esthetic evaluation should be performed and details documented. This is vital when dealing with extractions in the esthetic zone or any extraction in the esthetically demanding or particular patient. Merely concentrating on the tooth to be extracted and the area of implant placement often leads to unfulfilled expectations for the patient and frustration for the practitioner. This evaluation should document the smile line to determine the extent of gingival display, the gingival margin positions of the adjacent teeth, including any asymmetries and lengths of papillae to help determine the inevitability or preclude the possibility of interproximal papilla loss (black triangles). In addition, malpositioned or rotated teeth should be noted, given their adverse effect on the adjacent alveolar architecture.

This esthetic evaluation will allow for accurate treatment planning and uncover the need for adjunctive therapy including presurgical orthodontics.<sup>11</sup> Orthodontic extrusion can very often reposition hard and soft tissues in order to help achieve an ideal final esthetic result. Orthodontics can also reposition teeth in order to create ideal intra-alveolar distances prior to dental implant placement. Currently accepted guidelines advocate a minimum of 2 mm of space between implant and adjacent tooth, and 3 mm between two adjacent implants in order to maintain interdental septa and interproximal soft tissue.<sup>12,13</sup>

### Periodontal Evaluation

A comprehensive periodontal evaluation is fundamental to the success of extraction site management. This includes periapical radiographs of the area of concern, preferably a full-mouth series or panoramic radiograph when appropriate. The periodontal assessment should document the periodontal biotype, pocket depths, recessions, mobility, furcation involvements, as well as the presence of plaque, including the extent of inflammation, and bleeding on probing. This evaluation will allow for an accurate prediction of the behavior of the adjacent soft tissues following extraction. Alveolar destruction is often masked by soft-tissue inflammation and edema. Extraction of teeth adjacent

to inflamed tissues, pathologic periodontal pockets or a reduced periodontium, will lead to marginal and interproximal tissue recession. Therefore, it is essential that periodontal disease be eradicated prior to implant placement and, if possible, prior to tooth extraction in order to accurately predict final tissue positions in preparation for implant placement. This will also allow the opportunity to alter the surgical technique when necessary to minimize the unfavorable hard- and soft-tissue changes and communicate realistic expectations to the patient. A comprehensive periodontal evaluation embraced within the prosthetic treatment plan including recognition of individual tooth prognoses is vital for proper diagnosis and treatment planning. Given the success and predictability of dental implants, it is no longer prudent to maintain periodontally and endodontically compromised teeth within complex or extensive prosthetic treatment plans.

### PERIODONTAL BIOTYPE

A subject of particular concern during the periodontal evaluation is the periodontal biotype.<sup>14</sup> A thorough understanding and documentation of the patient's periodontal biotype is critical in order to predict hard- and soft-tissue healing, as well as to allow modification of the surgical techniques to enhance esthetics. This understanding also will aid in patient communication and expectations. In a clinical study, two distinct tooth forms were observed and correlated with various soft-tissue clinical parameters leading to two discrete periodontal biotypes.<sup>15</sup>

The thick, flat periodontium is associated with short and wide tooth forms. This biotype is characterized by short and flat interproximal papilla, thick, fibrotic gingiva resistant to recession, wide zones of attached keratinized tissues and thick underlying alveolar bone which is resistant to resorption.<sup>10</sup> Wound healing is ideal in these situations with minimal amounts of bone resorption and soft-tissue recession following surgical manipulations, including extractions and implant surgery. Ideal implant soft-tissue esthetics can be predictably achieved in these patients without modifications to routine surgical protocols.

In contrast, the thin, scalloped periodontium is usually associated with long and narrow tooth forms. This biotype is characterized by long and pointy interproximal papilla, thin, friable gingiva, minimal amounts of attached keratinized tissues and thin underlying alveolar bone, which is frequently dehiscenced or fenestrated.<sup>10</sup> Following surgical procedures, marginal and interproximal tissue recession in conjunction with alveolar resorption can be expected in patients with this biotype.<sup>14</sup> Modifications of routine surgical protocols are necessary for these situations. A careful and atraumatic extraction technique using microsurgical instrumentation such as periostomes is vital to help preserve alveolar architecture. Site preservation

techniques using bone graft materials can help reduce the extent of bone resorption.<sup>4,5</sup> Soft-tissue grafts, in conjunction with the extraction and implant placement, can help augment and offset the expected tissue recession. Prosthetic tissue manipulation using the interim prosthesis can help guide soft-tissue healing and establish an esthetic tissue profile.<sup>16</sup>

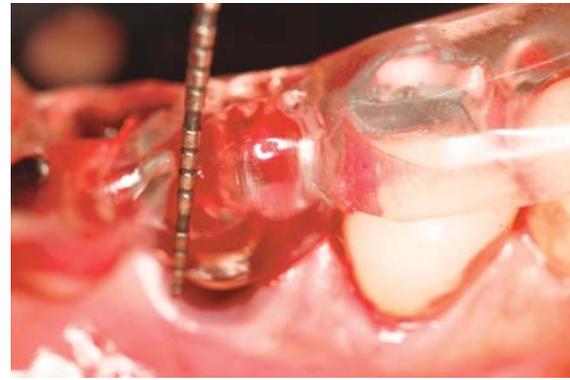
Periodontal biotype classification is very often difficult to distinctly classify. Patients frequently present with a moderate biotype. The two biotypes reported represented the extreme tails of the bell curve with the great majority (80%) of the assessments falling in the center of the curve.<sup>15</sup> This moderate biotype presentation can often deceive the practitioner in believing he or she is dealing with a thick, flat periodontium, thus, expecting minimal tissue changes when in fact, the tissue healing response behaves as the thin, scalloped biotype. Therefore, many of the routine surgical protocol modifications previously mentioned used to deal with the thin, scalloped biotype should be considered in these moderate biotype situations as well.

### EXTRACTION DEFECT ASSESSMENT TECHNIQUES

Following tooth extraction, the dental implant treatment sequence is largely determined by the integrity of the existing hard and soft tissues.<sup>11</sup> Careful assessment of the extraction defect is therefore paramount to the success of esthetic implant procedures. Extraction defect assessments can be made with or without flap reflection. Given the improved soft-tissue response with flapless procedures, assessment of the extraction defect in this manner will be more challenging but preferable. A surgical template that displays the position of the restorative margin of the future restoration is essential for this classification and used to guide assessments.

Following tooth extraction, a visual inspection of the socket bony walls is initially made. Recognition of the number of remaining socket walls and their condition is vital for this classification. Assessment of the gingival margin position and interproximal papillae and their relationship to the underlying alveolus is also vital. Classification of the periodontal biotype with associated risk assessment for potential recession is then determined. An additional important component of this evaluation also includes noting the degree of blood flow and potential for clot formation. A thorough debridement of the extraction socket and removal of all granulosomatous tissue is performed and necessary to promote osseous repair.<sup>17</sup>

Extraction defect sounding is then performed. Using the tip of a conventional periodontal probe, the socket is thoroughly explored. Initially, the crest of the extraction defect is evaluated, noting the position of the crestal bone in relationship to the gingival margin, as well as to the future prosthetic gingival margin using the prefabricated surgical template (Fig. 1). Any discrepancies between these two relationships should be noted. The risk of soft-tissue recession is proportional to the distance



**Fig. 1:** The EDS classification uses a surgical template to make measurements to critical landmarks immediately following tooth extraction

between existing bone and soft-tissue; the more distant the position of the alveolus to the soft-tissues, the greater the risk of gingival recession. Sounding of the bony crest includes the buccal and palatal plates as well as the interproximal bone peaks. Further examination of the buccal plate is then performed. While applying slight digital pressure on the outer buccal plate, the periodontal probe explores the inner aspect. This evaluation will uncover any fenestration or dehiscence-type defects. In addition, when sounding the inner aspect of the socket with a probe, any vibrations felt digitally will indicate a thin alveolar plate. A similar evaluation is also performed on the palatal plate. The thickness of the buccal plate is evaluated visually and digitally using a probe, as well as through manual palpation while sounding the inner aspect. A thin buccal alveolar plate often leads to partial or complete buccal plate loss following healing. When inadequate socket bleeding is present, perforations of the cribriform plate with a periodontal curette or rotary instrument is performed to facilitate wound healing.

### EXTRACTION DEFECT SOUNDING CLASSIFICATION

A novel extraction defect classification is outlined in Table 1 and illustrated in Figure 2. The EDS, extraction defect sounding, classification describes the condition of the hard as well as soft tissues immediately following tooth removal, prior to healing and remodeling of the extraction socket and provides basic treatment guidelines to achieve predictable implant integration and esthetics. This classification only applies after the treatment decision has been made to remove a tooth and an objective evaluation of the extraction defect is made.

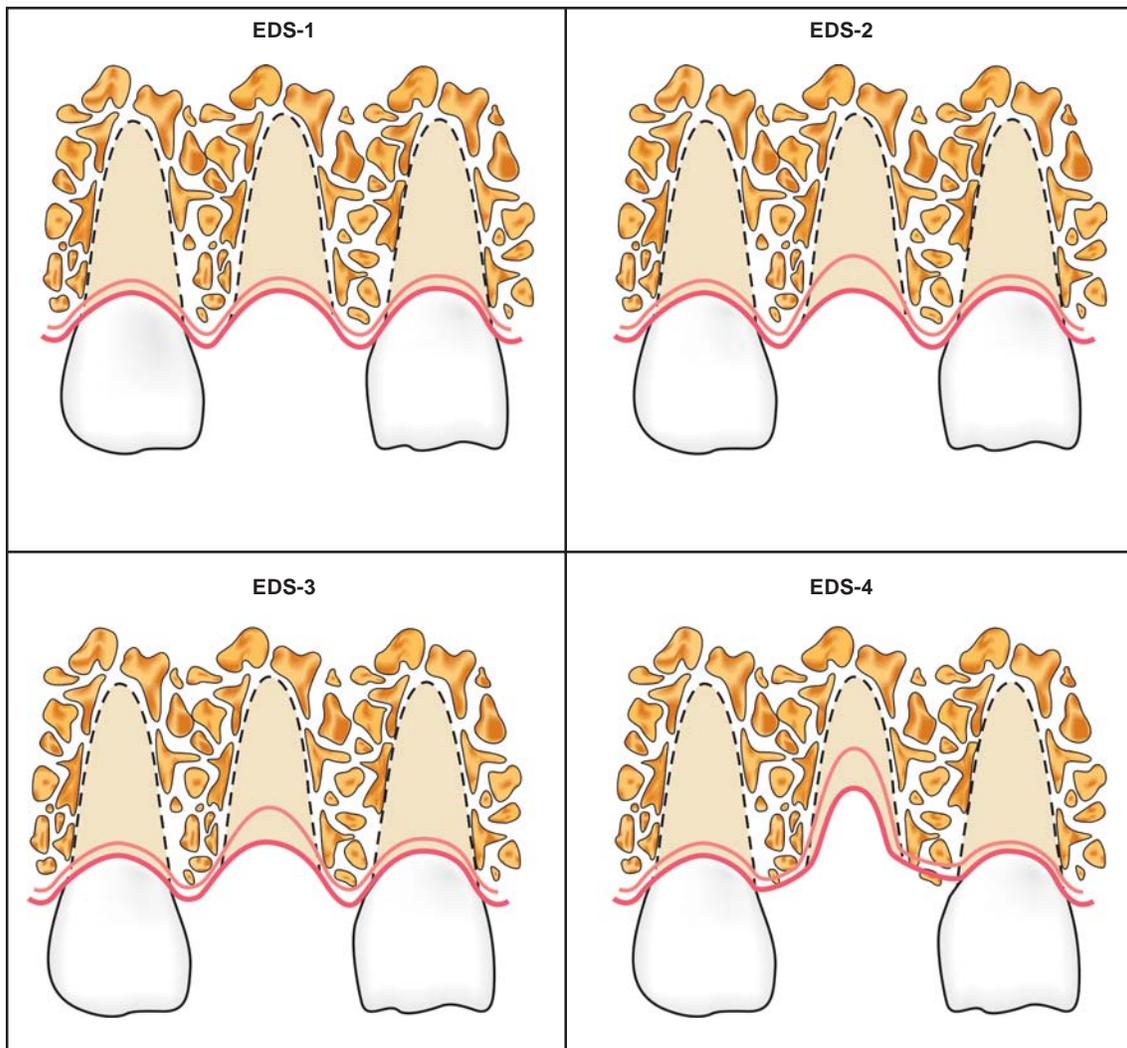
#### Extraction Defect

##### *Type 1*

The EDS-1 is characterized by a pristine, undamaged single-rooted socket, with a thick periodontal biotype in a systemically healthy patient. This defect allows for predictable immediate

**Table 1.** The extraction defect sounding classification

<i>Defect type</i>	<i>General assessment</i>	<i>Socket walls affected</i>	<i>Biotype</i>	<i>Hard tissue</i>	<i>Distance to reference</i>	<i>Ideal soft-tissue</i>	<i>Treatment recommendations</i>
EDS-1	Pristine	0	Thick	0 mm	0-3 mm	Predictable	Immediate implant (one-stage)
EDS-2	Pristine to slight damage	0-1	Thin or thick	0-2 mm	3-5 mm	Achievable but not predictable	Site preservation or immediate implant (one- or two-stage)
EDS-3	Moderate damage	1-2	Thin or thick	3-5 mm	6-8 mm	Slight compromise	Site preservation then implant placement (two-stage)
EDS-4	Severe damage	2-3	Thin or thick	≥ 6 mm	≥ 9 mm	Compromised	Site preservation then site development then implant placement (three-stage)



**Fig. 2:** EDS defects

implant placement in a prosthetically ideal position.<sup>6,18</sup> An atraumatic surgical technique is vital in preparation for immediate implant placement and is a unique and more time-consuming process in contrast to conventional extraction techniques. This involves the use of microsurgical instrumentation such as periostomes and other similar devices and an acute regard to the preservation of tissues during tooth removal. The EDS-1 has four intact bony walls including a crestal buccal plate thickness of 1 mm or more. With the surgical template in position and using the cervical margin of the future restoration as a reference, the gingival margin should be at the level or above the reference point and the alveolar crest should be no more than 3 mm beyond.

### Type 2

The EDS-2 is any socket with up to a mild degree of crestal bone damage or interproximal tissue loss of 2 mm, with a thin or thick biotype, a buccal plate thickness of less than 1 mm, or any combination thereof, in a systemically healthy patient. No more than one socket wall is compromised. The EDS-2 includes fenestrations that do not compromise the integrity of the crestal aspect of the buccal plate, such as apical endodontic damage. Another example of an EDS-2 would include an ideal socket as defined by the EDS-1 that has a thin instead of thick biotype. A further example would include a single-rooted bicuspid socket where the distance between the restorative margin of the surgical template and the alveolar crest is greater than 3 mm but no more than 5 mm. All multiple-rooted sockets with any of the above conditions are considered EDS-2.

### Type 3

The EDS-3 is broadly defined. It is generally characterized by moderate compromise of the local tissues in a systemically healthy patient. This includes a vertical or transverse hard- and/or soft-tissue loss of 3 to 5 mm, one or two compromised socket walls, a thick or thin periodontal biotype, or any combination thereof. With the surgical template in position and using the cervical margin of the future restoration as a reference, the gingival margin is positioned 3 to 5 mm away from this cervical margin reference point and the crest 6 to 8 mm away. This type of defect does not allow for routine immediate implant placement given the greater risk of recession, implant exposure, implant malpositioning, inadequate initial implant stability, or reduced bone-implant contact. Examples of an EDS-3 defect include any socket with a buccal plate dehiscence of 7 mm from the reference point. Another example would include a tooth with interproximal bone or soft-tissue loss of 4 mm.

### Type 4

The EDS-4 is characterized by a severely compromised socket with greater than 5 mm of vertical or transverse loss of hard and/or soft tissue, two or more reduced socket walls in a systemically healthy individual. The periodontal biotype in

these situations is either thick or thin. Immediate implant placement in these situations is not possible without compromised implant stability or significant amounts of implant body exposure. Examples of an EDS-4 defect include sites with an extensive history of periodontal pathosis leading to a severely reduced alveolar housing with destruction of the buccal and palatal plates. Another example would include greater than 5 mm of interproximal bone loss between multiple-tooth extraction sockets. With the surgical template in place, the distance between the gingival margin and the restorative cervical margin exceeds 5 mm. The alveolar crest is positioned greater than 8 mm away from this reference point.

## TREATMENT RECOMMENDATIONS

The recommended treatment protocol for the EDS-1 is immediate implant placement following tooth extraction. Ideal soft-tissue esthetics are predictable (Figs 2A to D). When immediate implant placement is beyond the surgeon's level of expertise or comfort zone, a two-stage approach is advised as described for the EDS-2.

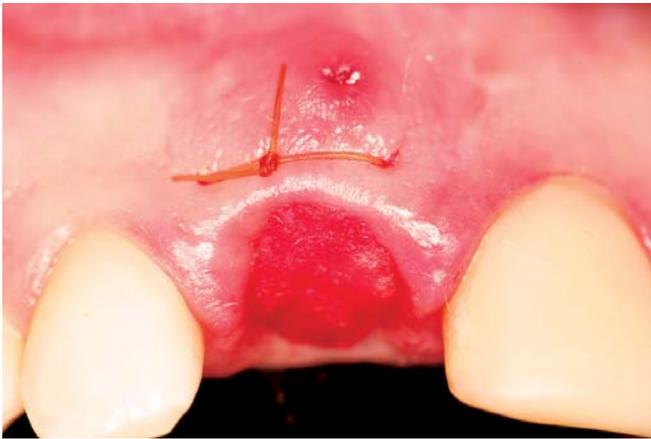


**Fig. 2A:** Atraumatic microsurgical extraction of a fractured maxillary right central incisor



**Fig. 2B:** Immediate implant placement is performed in this EDS-1 defect





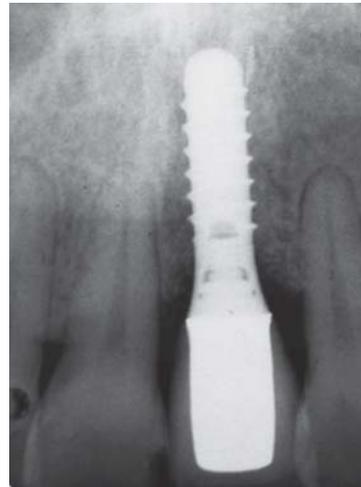
**Fig. 3D:** A resorbable collagen membrane contains the graft and is secured with a single overlay suture



**Fig. 4B:** A two-stage procedure is pursued including site preservation and development using a bone and soft-tissue graft for this EDS-3 defect

contain the graft and reconstruct missing bony walls including the alveolar crest. In addition, an interpositional connective tissue graft should be considered whenever a soft-tissue deficit is present or a thin periodontal biotype exists in order to enhance soft-tissue thickness or compensate for the thin biotype where recession is anticipated. Implant placement follows three to six months later allowing for adequate wound healing and graft remodeling. Ideal soft-tissue esthetics is often achievable but not always predictable for the EDS-2.

The recommended treatment protocol for the EDS-3 is a two-step implant placement approach with site preservation techniques performed at the time of tooth extraction followed by implant placement three to six months later as described with the EDS-2 (Figs 4A to D). A secondary procedure to perform site development may be necessary in some situations. Ideal soft-tissue esthetics is achievable but not predictable in the EDS-3. A slight esthetic compromise involving minor interproximal tissue loss or marginal recession can be expected with the final restoration.



**Fig. 4C:** Periapical radiograph one year following final insertion of the implant supported crown



**Fig. 4A:** Severe external resorption of the maxillary left central incisor



**Fig. 4D:** Slight esthetic compromise of soft tissues with minor interproximal papilla loss can be expected in the EDS-3 defect. (Restoration by Monica Trieu, DDS, Irvine, Calif)

The recommended treatment protocol for the EDS-4 is usually a three-step implant placement approach (Figs 5A to F). Site preservation is performed at the time of tooth extraction as for an EDS-2 defect. Placement of a graft material serves to preserve the existing alveolus. A resorbable membrane is used to contain the

graft and provide space for a modest regenerative response. The addition of a connective tissue graft will help enhance the soft-tissue profile and prepare for future primary closure during the subsequent second-stage regenerative procedure. A site development procedure then follows approximately three months



**Fig. 5A:** Severe loss of alveolar bone around the maxillary left lateral incisor and canine associated with orthodontic extrusion of the previously impacted canine



**Fig. 5D:** A connective tissue graft is placed over the membrane prior to surgical closure to enhance the soft-tissue profile and reduce the risk of premature membrane exposure



**Fig. 5B:** A three-stage process is pursued for this EDS-4 defect. Site preservation is initially performed using a resorbable bone graft to augment the extraction socket and a connective tissue graft to expand the soft-tissue profile



**Fig. 5E:** Periapical radiograph following one year of function of the implant supported fixed partial denture



**Fig. 5C:** A site development procedure is performed three months following the site preservation procedure using autogenous bone harvested from the symphysis, in conjunction with a space-providing e-PTFE membrane



**Fig. 5F:** Moderate esthetic compromise to soft-tissues with minor interproximal papilla loss and gingival margin recession can be expected in the EDS-4 defect (Restoration by Glenn Bickert, DMD, Laguna Hills, Calif)

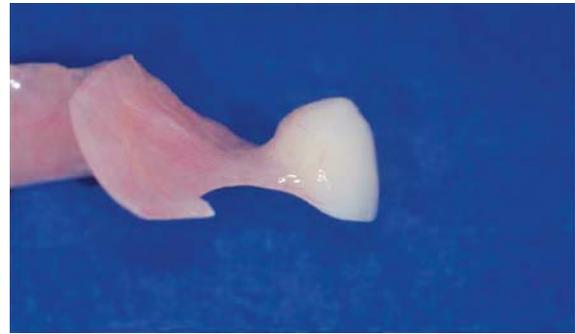
later allowing for adequate wound healing. The defect prior to this procedure is a combination-type defect with a loss in both height and width. Multiple site development procedures may be necessary for this type of defect.<sup>21</sup> Alternatively, a defect repair procedure can occur concurrently with implant placement following the principles of guided bone regeneration.<sup>20</sup> However, the quantity of bone developed around the implant and degree of implant integration of this regenerated bone may be less predictable than a staged approach.<sup>20,22</sup> The use of autogenous bone for site development in either block or particulate form, or combination is preferable for these challenging defects.<sup>23,24</sup> When autogenous bone is used in particulate form, membranes are beneficial in order to stabilize the graft, preclude soft-tissue invagination and provide space for regeneration. A connective tissue graft is once again performed in order to enhance soft-tissue esthetics, as well as to minimize the risk of premature wound dehiscence and graft or membrane exposure. A three- to six-month healing period is required prior to the subsequent surgical procedure necessary for implant placement. Ideal soft-tissue esthetics is usually not achievable in the ED-4. A minor to moderate compromise involving modest interproximal tissue loss and/or marginal recession can be expected.

### PROSTHESIS-GUIDED TISSUE HEALING

Following tooth extraction, classification of the defect and recommended treatment protocols, development and maintenance of esthetic soft-tissue architecture is essential. Interim prosthetic devices are useful in order to manipulate and guide soft-tissue healing and esthetics following tooth extraction and subsequent site preservation and development procedures (Figs 6A and B). These devices include custom healing abutments and ovate pontic designs incorporated within fixed and/or removable interim prostheses.<sup>16</sup>

Ovate pontic designs are beneficial in preserving or establishing esthetic soft-tissue emergence profiles following site preservation or development surgery. After creating a master cast to fabricate the provisional, surgery is performed on the cast, removing the stone teeth to be extracted, and then creating a concavity within the model, partially simulating the extraction defects. Ovate pontics apply maintenance pressure on the gingival margin and interproximal papillae, minimizing the tissue collapse following tooth extraction. They can be incorporated within fixed as well as removable transitional restorations either chairside or in the laboratory using conventional acrylic or composite.

The ovate pontic surface should extend 2 to 3 mm within the extraction defect and apply facial but not apical pressure on the free gingival margin. It should only apply slight lateral pressure on the existing interproximal papillae and also provide room for coronal enlargement of the papilla to accommodate for inflammation. When removable provisionals are employed, they



**Fig. 6A:** Profile of a removable transitional appliance with an ovate pontic design



**Fig. 6B:** An ovate pontic can guide tissue healing and help improve soft-tissue esthetics

should include positive rest seats and adequate retention to prevent excessive compression of the extraction defect, augmentation materials and associated tissues.

### DISCUSSION

When implant dentistry is anticipated following tooth extraction, the clinician is faced with many choices. One option is to immediately place an implant into the fresh extraction socket.<sup>7</sup> Another option is to perform site preservation and then place the implant in a secondary procedure following healing.<sup>10</sup> A third option is to allow the socket to heal naturally, and then place the implant in a secondary procedure with associated fenestration or dehiscence-defect repair when necessary.<sup>20</sup> One final option is to perform site development to reconstruct the defect created due to physiologic socket healing and re-enter the site for the subsequent implant placement procedure.<sup>23</sup> In addition, extraction sockets are often damaged so extensively multiple augmentation procedures are necessary to adequately develop the site with ideal soft-tissue esthetics. The proposed extraction defect classification attempts to categorize the most common extraction defect presentations and simplify the treatment decision-making process.

Several alveolar defect classification systems have been previously reported and are in current use.<sup>21,26,27</sup> All of these existing classifications however, describe the condition of the hard and/or soft tissues of an already-healed edentulous site. A classification of the extraction defect immediately following tooth removal and prior to healing and remodeling which provides guidelines for implant treatment is currently not available.

The frequently used classification introduced by Seibert in 1983, and the less-commonly cited by Allen *et al.* in 1985, generally describes three types of clinical defects and presents treatment recommendations and techniques to predominantly improve the clinical soft-tissue deficit.<sup>21,26</sup> Treatment recommendations are proposed in order to enhance esthetics in preparation for conventional prosthodontics, including pontic sites. The three basic categories of defects reported by Seibert were subclassified by Wang in 2002 based on their size.<sup>27</sup> The authors offered therapeutic guidelines using their classification directed toward successful dental implant placement. The commonly referred to classifications by Lekholm and Zarb and Misch and Judy describe five and four degrees of alveolar resorption, respectively, following tooth extraction and physiologic remodeling. Soft tissues are not considered. Treatment recommendations are made directed toward successful implant placement and integration in addition to prosthetic treatment planning.<sup>28,29</sup> The preceding classifications all described an already-healed alveolus following tooth extraction and physiologic remodeling.

Salama and Salama proposed a similar classification to the one currently proposed in 1993.<sup>11</sup> The authors described various presentations of extraction defects or “environments” offering implant management guidelines. The authors distinguished between three types of extraction environments based on a subjective evaluation of the extent of bone and soft-tissue destruction classified as incipient, moderate, or severe. The authors recommended immediate implant placement with guided-tissue regeneration techniques if necessary for a Type I or incipient defect. They introduced the concept of orthodontic extrusion for a Type II or moderate defect and ridge augmentation for a Type III, or severely compromised defect. Since the Type II defect is an assessment prior to tooth extraction, at least part of their classification was based on pre-extraction tissue architecture. Further, the assessment techniques used to classify the defects were not presented as with the currently proposed classification.

The extraction defect sounding classification defines the condition of the hard and soft tissues immediately following tooth extraction, attempts to predict the wound healing response, and provides basic treatment guidelines to achieve predictable implant integration and esthetics. Treatment recommendations using this classification are conservative, focus on predictability of implant integration, and provide realistic esthetic expectations. This classification uses an objective method to evaluate the integrity of the hard and soft-tissues immediately

following tooth extraction using a periodontal probe in a manner often described as sounding, in conjunction with a prosthodontically derived surgical template used as a reference point.<sup>30,18</sup>

The EDS classification recognizes the varied wound healing response between thick and thin biotypes following surgical procedures.<sup>14</sup> The thick, flat periodontium is associated with short and wide tooth forms, and is characterized by short and flat interproximal papilla. The gingiva is thick and fibrotic with wide zones of attached keratinized tissues and generally resistant to recession. Wound healing following extraction is ideal in these situations as described for the EDS-1 defect. Therefore, with an undamaged extraction defect, immediate placement can predictably yield ideal soft-tissue esthetics. In contrast, the thin, scalloped periodontium is usually associated with long and narrow tooth forms, and by long and pointy interproximal papilla. The gingiva is thin and friable with minimal amounts of attached keratinized tissues and thin underlying alveolar bone, which is frequently dehiscid or fenestrated.

Following surgical procedures, marginal and interproximal tissue recession is common, as well as significant buccal plate alterations as described for the EDS-2 defect. Therefore, a two-stage approach is recommended and extra care urged when immediate implant placement is performed. When the integrity of the hard and soft-tissues has been moderately compromised as described in the EDS-3 defect, either through periodontal or endodontic pathology or damaged during tooth removal, site preservation has been advised. When severe loss of bone and soft tissue will compromise the success of implant integration or create severe esthetic compromise, a process of site preservation followed by site development is often necessary as described for the EDS-4 defect.

## CONCLUSION

Tooth extraction is a traumatic procedure often resulting in immediate loss of alveolar bone and soft tissues. A complex cascade of biochemical and histologic events occurs during the wound healing process, which further leads to physiologic alterations of the alveolar ridge. Therefore, site preservation involving atraumatic extraction techniques, application of biomaterials within the alveolar socket, including the use of membranes and soft-tissue grafts, should be considered an essential component of routine dental extraction surgery, especially in the esthetic zone.

A novel extraction defect classification system has been introduced. The EDS classification system describes the condition of the hard and soft tissues immediately following tooth removal, prior to healing and remodeling of the extraction socket, and provides basic treatment guidelines to achieve predictable implant integration and esthetics.

The EDS classification system focuses on the predictability of implant integration and esthetics, and is conservatively based with respect to treatment recommendations. This classification uses an objective method to evaluate the integrity of the hard

and soft-tissues immediately following tooth extraction using a periodontal probe in conjunction with a prosthetically derived surgical template used as a reference point. Extraction defect management guidelines are based on the alveolar and soft-tissue architecture, the periodontal biotype, systemic condition of the patient, realistic esthetic expectations, and the most predictable way to treat the particular situation using dental implants.

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