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# Restoration or implant placement: a growing treatment planning quandary

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Each year endosseous dental implants gain greater acceptance among clinicians and patients. This has come about for several reasons, including excellent success rates published in long-term studies, improvements in fixture and abutment designs, more predictable surgical placement techniques, and increased consumer desire to have tooth replacement. Regardless of the implant system, the placement and functional success of endosseous implants is greater than 90% (1, 14, 38, 41). Thoughtful decision-making is vitally important as patients seek professional advice on retaining their teeth or replacing them with implants. Is a tooth with a questionable prognosis restored or intervened with a dental implant? Answering such questions is a challenge for clinicians and patients alike.

The restorative dentist and surgeon working together must consider many factors in treatment planning. While the predictability of implants has greatly improved, it is not 100%, making it difficult to recommend the extraction of a tooth with a less than optimal prognosis. Should a tooth with a large post and core restoration and a failing endodontic procedure be re-treated conventionally or should it be extracted? Is it better to replace such a tooth with an implant? If the implant fails to integrate or if the restoration is an esthetic failure, would it have been better to retain the tooth? The American Academy of Periodontology's position paper on dental implants cites that all patients should be informed of the risk of failure and alternative treatments prior to implant placement and restoration. The greater than 98% implant success reported in some studies may be a dangerous benchmark if questionable teeth are too often extracted.

This chapter discusses the clinical and economic factors to be considered in making these decisions. Four clinical scenarios related to implant placement that require careful thought are discussed: the heavily restored tooth with a poor restorative prognosis; the periodontal furcation-involved molar; the advanced periodontal patient facing a complete periodontal prosthesis, and difficult anterior esthetic cases where the cosmetic result with an implant can be unpredictable.

## Clinical factors

### The heavily restored tooth

There may be many treatment options for heavily restored teeth. These teeth may have been restored multiple times, leaving minimal external coronal dentin for an adequate restorative ferrule. Frequently they need another endodontic procedure as well as a post. The post space can be so large that the internal dentinal walls of the preparations are too thin for adequate ferrule length or strength. Published data recommend that supporting coronal dentin of greater than 1 mm in height is needed to provide a ferrule necessary for predictable retention form even with a post (23, 39, 59). The thickness of the remaining internal dentin is also critical (15). Teeth that have had several post spaces prepared commonly have minimal width to the internal dentin walls. This is also a problem in narrow thin root forms like mandibular incisors, bicuspids and lateral incisors. Exceptions to these general guidelines can be made, especially when considering the occlusal load a tooth will receive. If greater than normal force is to be exerted on a tooth, then all attempts to increase

**Fig. 1. Extensive decay creates the dilemma to restore or extract. The cost of restoring and the predictability of the outcome make replacement with an implant a more realistic option.**

the resistance form should be made (6, 60). Crown lengthening can provide this increased resistance but at the expense of removing supporting bone on adjacent teeth. Orthodontic extrusion can also be considered, but extrusion adds both additional financial cost and increased time to the treatment. In Fig. 1 it is evident that there is a need for crown lengthening. The financial cost of extrusion, surgery, endodontic re-treatment, post, core, and a crown would be significantly more than an extraction and a restored implant. The long-term prognosis with an implant may also be better. Since immediate implant placement is a possibility with single-rooted teeth and premolars, fewer office visits may be required. Immediate placement is now widely accepted and predictable (52, 69), and immediate implant placement along with single-stage surgical placement limits the number of procedures.

The difficulty of deciding to retain a heavily restored tooth is increased by the many innovative procedures available. Most implant cases can be planned with single-stage surgical techniques. These have the similar success rates as the previous two-stage designs (4, 5, 14, 24, 41). The original Branemark operating room set-up has been challenged, which has in turn decreased the complexity and cost of placing implants (54). When comparing the costs and the number of office visits required for the conventional restorative treatment heroically to treat a tooth, it may be better to extract it. The predictability of regenerative procedures with implant site development has changed some older concepts of retention of a tooth with a questionable prognosis. Before the acceptance of sinus augmentation procedures, the choice might have been to retain teeth with root resective and endodontic re-treatment procedures. Previous publications on implants in the posterior maxillae or mandible indicated that use in these areas was less than ideal (34). This was usually due to short fixture lengths required to avoid vital anatomical structures, but now the success of implants in augmented sites is better than 90% (45, 63, 65) because of improved implant designs and site regenerative procedures. Augmentation procedures allow longer and wider diameter implants, improving their success in these difficult areas. Research with micro and macro rougher implant surfaces has also increased success (20). Staying abreast of changes in surgical and restorative procedures is important so that the most appropriate care can be offered. For example, cemented restorations are now the standard for most cases as opposed to the previous practice of exclusively using screw-retained types of restorations (62).

Endodontic re-treatment and retention of teeth should be reconsidered anytime pure endodontic failures are diagnosed. The process of determining cause of failure and in assessing the future restorability of the tooth requires careful thought. Is there adequate root length for an endodontic seal apical to a post (28)? Is there a possibility of an existing incomplete vertical root fracture (30, 59, 64)? Are the occlusal forces going to contribute to failure (50, 60)? Would it be better to sacrifice the tooth for an implant to better distribute occlusal forces? (Fig 2, 3)

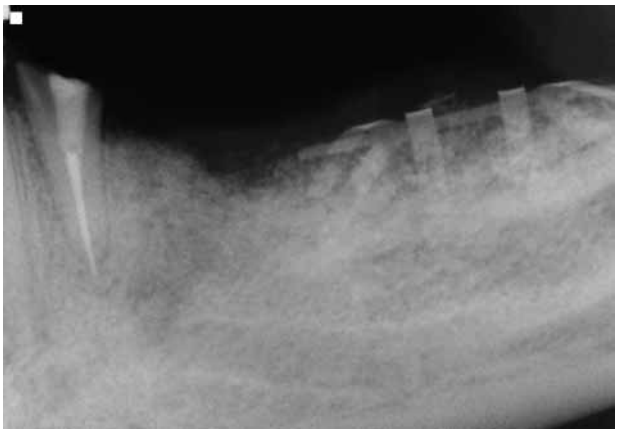

**Fig. 2. The radiographs here and in Fig. 3 show a case where the mandibular left first premolar could perhaps be retained, but it may be better to extract and use the site for an implant. This allows the lower left quadrant to be restored with an implant-supported fixed partial denture. By using the first premolar site for implant placement, the surgeon can avoid the mental foramen in the second premolar area.**

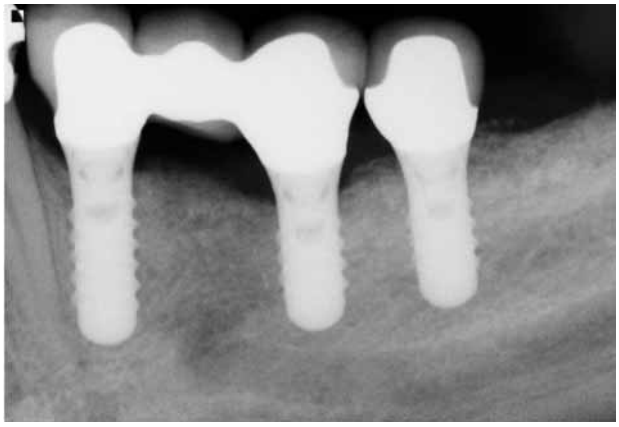

**Fig. 3. Final implant-supported restoration replacing the first bicuspid and the grafted ridge with three fixtures from the case shown in Fig. 2.**

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The decision to place an implant is not based solely on anatomical sites but on the patient as a whole. Decisions may change if the patient is a heavy smoker or if they are an uncontrolled diabetic, factors which could compromise implants. Because of these significant risk factors, it may be better to retain existing teeth even though they may be lost than to place implants (8, 21). The heavily restored tooth poses several challenges and adds many contributing factors to the equation. In all cases the surgeon should consider the consequences of failed therapy. This consideration relates not only to heavily restored teeth but also to periodontally involved multirooted teeth with significant furcation invasion.

## The furcation-involved tooth

Reducing attachment levels for crown lengthening or for root resective procedures can be appropriate for the short-term but may have a negative long-term impact. Periodontally involved molars are the most common teeth lost. The classic study by Hirschfeld & Wasserman reported that over a 22-year period there was a loss of 31.4% of molars compared to 4.9% of single rooted teeth (33). Thus, decisions to retain or extract a tooth frequently involve molars. The furcations and the concavities associated with them make them difficult to treat. Resecting roots can improve debridement access, but the utility of resecting roots has been debated over the last 30 years, and the literature differs as to the success of root amputations or hemi-sections. In Buhler's (12) review of the literature he found several variations on the definitions of failure and success. Langer and Buhler report poorer success rates than others (13, 22, 29, 37). The most common reasons for failure were recurrent decay and endodontic failure. Root fractures and, less commonly, recurrent periodontal disease were also implicated. When clinical success is likely, these root-resection procedures make financial and clinical sense. (Fig. 4) shows a tooth that has already had a successful endodontic procedure. The mesial buccal root is fractured and the root amputation only requires surgical and restorative procedures. One clinical dilemma is the amount of bone required to properly resect a root. Resection may require osseous removal to the adjacent teeth, as crown lengthening does. If osteoplasty/ostectomy is not performed then plaque-retentive areas are created which may promote root decay and/or periodontal disease.

The root trunk shape and size are also to be considered. When performing a hemi-section, the length of the root trunk affects how much bone is removed from the remaining root and the adjacent teeth. The lip of dentin in the furcation must be recontoured as well as the bone. The restorative finish line must extend into these areas and the margin cannot be left in an infrabony-type defect. To create a positive osseous architecture a large amount of bone must be

**Fig. 4. Endodontic therapy and crown restoration were successful for a number of years. Mesial root was recently fractured. Removal of the mesial root is a cost-effective procedure rather than extraction and placement of an implant.**

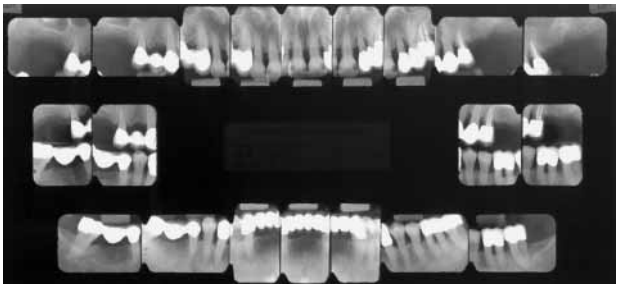

**Fig. 5. Today implants can simplify the complexity of the final restorative plan and also keep key segments of the arch independent. The treatment plan is scheduled for extraction of the left lateral incisor, left first premolar and both left mandibular molars. Implants simplify problems with minimal interocclusal space. The anterior segment can be restored separately with a conventional fixed bridge.**

removed on the remaining root and the adjacent tooth. The amount of bone removed is increased with a long root trunk. If the tooth later fails due to a fracture or decay, then the clinical situation for an implant is compromised. If the tooth was vital then the financial cost may also be too great. In such a situation an implant or a fixed conventional bridge may be more prudent. If the patient's anatomy requires sinus augmentation, then the clinician may reconsider treating the tooth with root resection.

## The periodontal-prosthesis patient

Patients with advanced periodontal involvement should have an annual comprehensive examination. This allows the clinician to review the entire dentition and thus helps prevent poor periodontal and restorative short-term decisions. Re-treating failed dentistry is more expensive than the cost of frequent thoughtful re-evaluations. This comprehensive examination includes not only a review of the overall restorative and periodontal needs, but also includes an evaluation of occlusion. Assessing the individual's susceptibility to attachment loss should be considered as well as how this susceptibility relates to the prognosis of strategic abutment teeth. Consideration should be given to the patient's compliance with oral hygiene, supportive therapy and fluoride regimens. In the past performing full mouth rehabilitations on patients with advanced periodontal disease and limited remaining support (46) was not uncommon. Today implants have decreased the frequent need for these complex periodontal-prosthesis restorative cases (44, 46).

Figure 5 demonstrates a situation that in the past may have required fixed splinting and cantilever fixed bridges to restore the maxilla. Implants simplify the final restorative plan and also allow key segments of the arch to remain independent. The plan is to extract the left lateral incisor, left first premolar and both left mandibular molars. The patient has a class II occlusion and the mandibular second molar is nonfunctional. This occlusal scheme will allow for two implants in the left posterior maxilla and two in the mandibular arch. Implants also simplify problems with minimal interocclusal space. The anterior segment can be restored separately with a conventional fixed bridge.

As stated earlier, implants allow independent treatment of the segments of an arch. In the past the periodontal-prosthesis-defined patient would have been treated with multiple root resective procedures and splinted fixed restorations. While this treatment option is occasionally still the best choice, it is less so today, where some teeth may be splinted and the teeth with a poor prognosis may be replaced with implants.

In patients who have already had prosthetic reconstructions, implants facilitate rescue procedures. Multiple implants can replace a segment without replacing large fixed bridges. In Fig. 6 the mandibular right canine is failing. Three implants are planned to replace the lower anterior teeth. The initial idea of

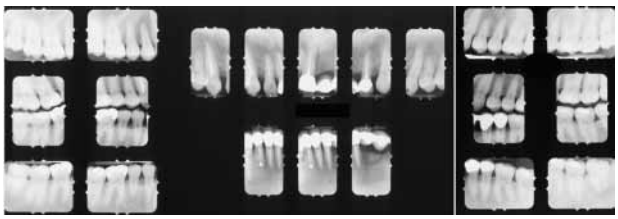

**Fig. 6. Patient has the mandibular right canine that is failing. Three implants are planned to replace the mandibular anterior teeth. Implants to replace one or more missing teeth and connecting to a natural tooth can prevent a large reconstruction of the entire arch and be financially beneficial for the patient**

**Fig. 7. Implants in the esthetic zone need to be placed ideally not where there is existing bone. The fixture placement resulted in fabrication of a ridge lap crown. This type of restoration complicates hygiene procedures**

**Fig. 8. Implants have significantly changed both staging and techniques for extracting teeth that are potential sites for implant placement and fixed denture pontic. Being able to make some critical treatment planning decisions prior to the extraction of the tooth can produce a more esthetic outcome and reduce both cost and time for the patient. Every effort is now taken to preserve the gingival tissues and avoid any compromise in the bone surrounding the socket.**

connecting implants to well-supported teeth is also being re-visited. Recent studies demonstrate that rigid connectors may be acceptable for connecting teeth to dental implants (42, 48). Implants replacing one or more missing teeth and connecting to a natural tooth can prevent a large reconstruction of the entire arch. Problems with intrusion seem to be associated more with semi-rigid connectors (42). While it may be prudent to plan implant restorations to stand independently, the literature indicates that it may be acceptable to connect an implant to a natural tooth (42, 48).

## Difficult anterior esthetic cases

The use of dental implants to replace anterior teeth is one of the last areas to gain acceptance by the dental profession. The replacement of anterior teeth with implants has significantly changed treatment-planning options. The dentist and the patient expect an anterior tooth replacement to be esthetic and predictable (17). With modern techniques and the materials, anterior restorations can frequently be fabricated to meet the patient's expectations. The greatest benefit of using implants in the anterior es-

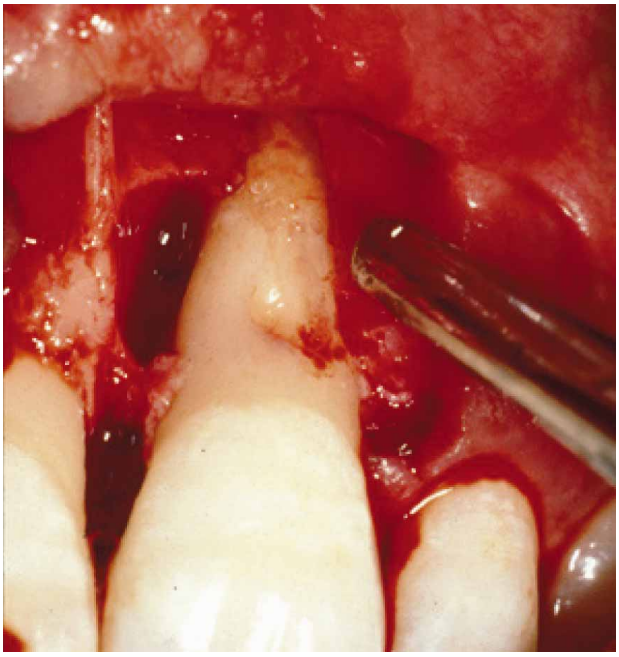

**Fig. 9. Teeth that are periodontally involved or that are fractured below the crestal bone once extracted normally heal with a significantly compromised ridge. Complete loss of labial plate and interproximal make this site ideal for grafting at the time of extraction**

thetic zone is the avoidance of unnecessary preparation of nonrestored teeth adjacent to an implant

When presented with the risks and benefits of all the types of available replacements, many patients choose the implant option. The patient as a consumer may be more informed about this option than the dentist. Patients may seek a second opinion if a fixed or removable partial denture is the only option a restorative dentist provides.

Placement of anterior implants is a more technical restoration than others available for these esthetic restorations (15). Professional acceptance of implants in the esthetic zone has increased because there are:

- better presurgical planning guidelines.
- more options in diameter of implant fixtures.
- greater variety of abutments.
- better fit of the abutment to the implant fixture.
- better placement of the fixtures accurately with surgical guides.
- better techniques for preparing the edentulous site.
- better prosthetic techniques to produce a highly esthetic final restoration.

The cost of a single implant compared to a fixed partial denture is comparable, while the preparation of the edentulous site can add additional cost and time for implants.

Although some anterior teeth are congenitally missing, most missing anteriors have been extracted secondary to trauma, endodontic complication, fracture, or periodontal disease. Rarely are these anterior sites without some compromise in the width and height of the edentulous ridge, gingival papillae height, or thickness of the overlying gingiva (1, 18). Q2
Ideally, implants in the esthetic zone (Fig. 7) should not be placed where there is existing bone (26), rather the edentulous ridge should be augmented to allow ideal implant placement. Whether an implant or fixed partial denture is utilized, most ridge defects need correction in order to achieve acceptable esthetics (1, 68). Patients with thick gingiva, thick alveolar bone, and square-shaped teeth tend to have less resorption of the remaining ridge than do patients with thin gingiva, thin bone, and a tapered tooth shape (43). A high smile line allowing gingival display is more challenging with a thin gingival architecture. This difficulty is similar for replacement with a dental implant or with a fixed partial denture. The replacement and restoration of anterior teeth with implants should be incorporated into a practice only after the surgeon and the restoring dentist have gained considerable experience with implants in nonesthetic areas (3, 67). The use of a diagnostic wax-up and proper radiographs early in the treatment planning stage can greatly aid in deciding the proper treatment option (32).

Implants have significantly changed both staging and techniques for extracting teeth that are potential sites for implant placement and fixed denture pontic. Being able to make some critical treatment plan- Q3
ning decisions prior to the extraction of the tooth can produce a more esthetic outcome and reduce cost and time for the patient. Every effort is now taken to preserve the gingival tissues and avoid any compromise in the bone surrounding the socket. The gingival tissues should be detached from the tooth with a sharp scalpel incision. If a forceps is used for the extraction, the clinician should avoid any compromise of the gingival tissues, and crestal

**Fig. 10. Orthodontic extrusion of the remaining root provides two significant advantages to the site. Both bone and soft tissue are coronally positioned. This additional bone and soft tissue usually enhances the site for a more esthetic final restoration. In addition, with the orthodontic extrusion the diameter of the remaining socket is much smaller and many times an implant fixture can be placed filling the remaining socket at the time of the extraction.**

and buccal plates of the remaining socket bone. Many clinicians now use a thin-bladed instrument (Peritome®) to extract single-rooted teeth, especially when there is inadequate tooth structure for the forceps to secure the root without damage to the tissue and bone (Fig. 8). The extraction socket must be meticulously debrided of all infected granulation tissue in the apical area of the socket as this residual tissue may prevent or delay healing of the socket with mature bone. Periodontal involved teeth or anterior teeth that are facially prominent normally heal with a significant ridge deformity (Fig. 9).

Treatment of the extraction socket is being more closely evaluated. There is a trend to graft the extraction socket in the hopes of reducing the degree of alveolar ridge resorption. This technique needs further long-term evaluation before it can be routinely recommended. Many biocompatible resorbable materials are currently available for grafting the alveolar socket; however, none have shown superiority over the other. They may preserve the gingival form and appear complete, but these materials are often encapsulated with connective tissue, and thus there is little bone formation. This goal of preventing ridge resorption is one that can be accomplished in several ways. One predictable method is through orthodontic extrusion for site development. Orthodontic extrusion of the remaining root provides two significant advantages to develop the site (Fig. 10). Both bone and soft tissue are coronally positioned. This additional bone and soft tissue enhances the site for a more esthetic final restoration. In addition, with the orthodontic extrusion the diameter of the remaining socket is much smaller, and often an implant fixture can be placed filling the remaining socket at the time of the extraction.

The placement of a temporary tooth that is contoured to preserve the gingival contours and avoid pressure on the socket is a critical step in site development for an implant or pontic replacement. Prior to the extraction, fabrication of an appliance with an ovate pontic rather than a ridge lap design is advantageous because the ovate pontic can preserve the form of the site.



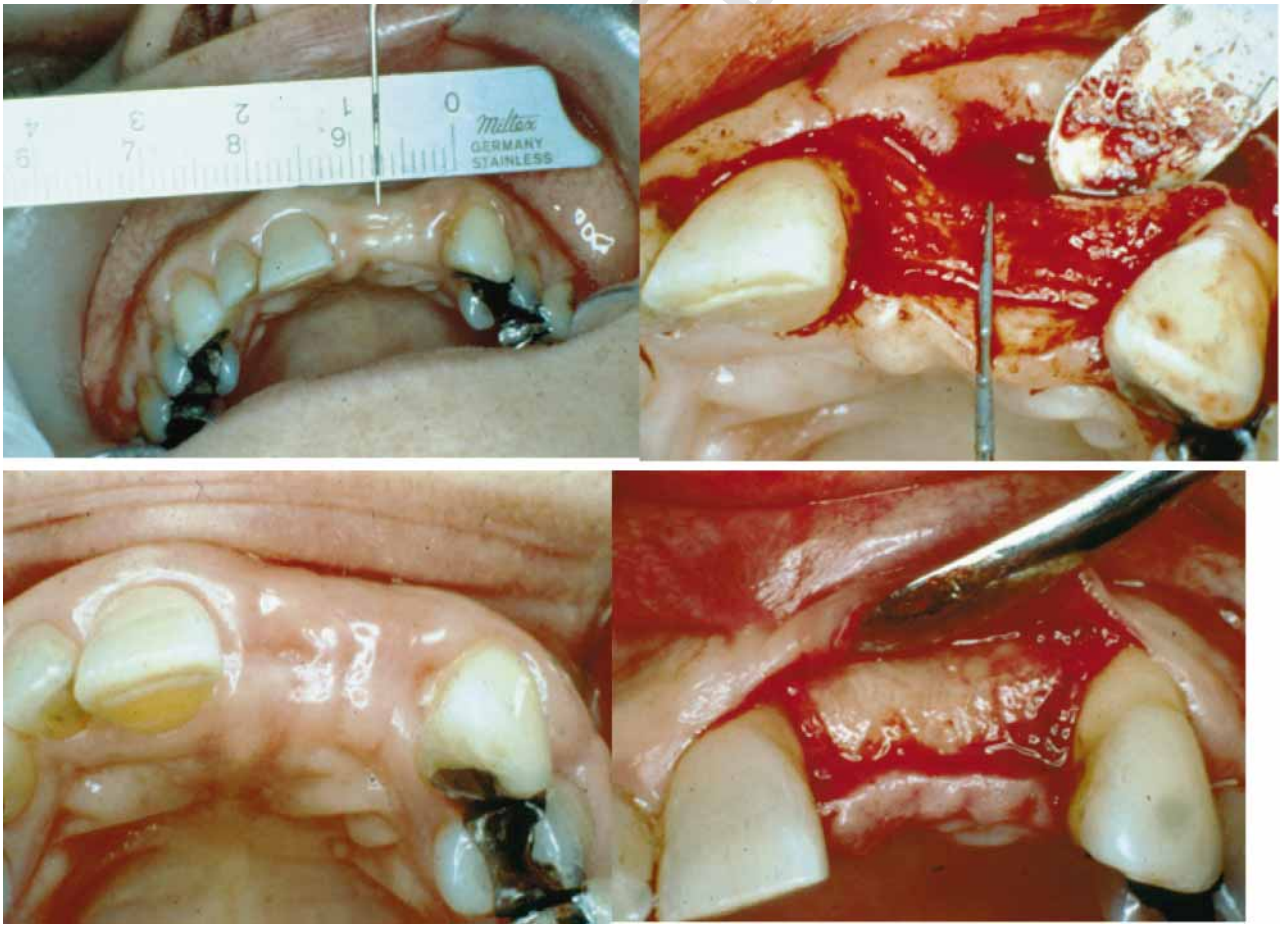


**Fig. 11. Techniques for regenerating bone have become well accepted by the dental profession. These techniques do add additional time and cost to the procedure but still avoid preparation of the adjacent teeth.**

Unfortunately the extractions are frequently carried out well before the implant is to be placed. Many of these edentulous sites have healed with a significant ridge deformity. This residual ridge deformity can compromise the placement of an implant and or the esthetic restoration of an implant. A tooth with a vertical fracture bucco-lingually through the root normally destroys the entire buccal plate of bone and, in some cases, the palatal plate as well. A number of techniques have been developed to regenerate lost hard and soft tissues (7).

There are three classifications of ridge deformities. Class I is the loss of buccal–lingual width, Class II is the loss of coronal height, and Class III is a combination of Class I and II (57). Class II and III ridge defects are difficult to augment, and the predictability of achieving an ideal esthetic result is questionable. Fortunately, the majority of the defects are Class I (1). Bone regenerating techniques are well accepted by the dental profession (Fig. 11). The horizontal type I defect is predictable to treat and horizontal augmentation procedures are widely used. These techniques add additional time and cost to the procedure but avoid preparation of the adjacent teeth.

## Economic factors

The literature clearly documents the predictability of dental implants (4, 14, 38, 41). The dental community and those that provide dental benefits should not consider implants experimental. Dentists who do not discuss with their patients the option of implants are not practicing up to today's standard of care. It is not an option for the restorative dentists to use the excuse that they are not trained to restore implants. They should offer this service or refer the patient to someone competent to perform the procedure. In the past, third-party dental benefit carriers have not included implants as a covered procedure. Recently however, some carriers are offering limited benefits for dental implants. Some cover both the implant and the final restoration and others cover only the restoration. Paradoxically, this is occurring at a time when dental benefits are being reduced industry wide because of cost containment by insurance carriers. They reduce benefits by increasing the co-pay, not adjusting the cap for inflation, or by limiting the procedures that are covered. This desire of the third-party benefit carrier to reduce benefits will limit the movement to fund implant procedures. Dental implants are denied for reimbursement simply because they are an excluded benefit in many plans, just like orthodontic benefits are. Many carriers do not deny that they are an appropriate treatment option; they simply state that implants are not covered.

Clinicians as well as patients feel this undue pressure and many times elect the 'best economic' option rather than the best treatment option. Professionally it is difficult to decide if retaining a tooth may compromise other teeth or the tooth site for a future implant should a patient later change their mind. If this decision is based on benefit coverage alone nonrestored teeth may unfortunately be prepared for abutment teeth. Is it ethical treatment to prepare healthy teeth for a bridge abutment in a healthy young patient? Would it not be better to do a temporary resin-bonded bridge until the patient can afford a dental implant?

Historically, dental benefits have decreased in the past decade. If this trend continues, perhaps even discussing insurance reimbursement will not be ethically correct. Discussing dental reimbursement draws the dentist into decision-making based on third-party providers. It may be better to give the patient options with the advantages and disadvantages of each, and let the patient research payment options on their own. If restoration of compromised dentition is based only on benefit coverage when an implant would be a better clinical option, how is this situation handled if the treated tooth soon fails? What if the site for an implant has now been compromised? Can clinicians rely on the fact that the patient chose this option?

Recommendations to patients should be evidence-based. Some still argue that the long-term success rates of implants are not high enough and that questionable teeth should be maintained until they become hopeless. The literature however, supports the success of dental implants (4, 14, 19, 38, 41). Fixed conventional bridges also have limited long-term success rates, but they do not equal implant-supported restorations. Scurria (56) looked at multiple studies and came up with the following success rates of conventional dentate bridges: 92% at 10 years and 75% at 15 years (56). Generally it is observed that at 15–20 years, more than 30% of dentate-fixed bridges have failed (40, 49, 56). Current studies of partially edentulous implant patients show implant success rates over 95% (5, 14) at 5 years. In younger patients, it is important to remember that any therapy performed may need to be retreated in 15–20 years. Removing sound tooth struc-

ture today with the knowledge that these same teeth will have to be retreated in the future should be avoided if possible. But, as has been discussed in this chapter, the heavily restored tooth or the periodontal compromised tooth may need to be sacrificed if retaining it will later compromise an implant site.

A clinician's current knowledge and treatment planning strategies must be regularly updated as advancements in dentate and implant therapies evolve. Clinicians have the responsibility to help guide patients to appropriate therapies that are predictable and as harmless as possible. Some consideration must be given as to the financial consequences of these decisions, but third-party benefit plans should not drive the treatment plans. Predictable longstanding therapeutic results will keep patients from being financially disillusioned. Giving strong credence to what benefit plans cover and retaining teeth where treatment soon fails will undermine the trust patients have in dentistry as a whole. The treatment-planning quandary of keeping or extracting a tooth becomes less of a problem when clinicians keep their knowledge and skills current, perform thorough comprehensive examinations, provide evidence-based treatment options, and decrease treatment-planning decisions around third-party benefits.

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