The Clinical Management of Periodontal Osseous Defects

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The therapeutic goals of the periodontist include the retention of the natural dentition by preserving and/or restoring the alveolar housing of the attachment apparatus. It is, therefore, necessary to identify aberrations in osseous structure in their incipient as well as the more advanced problems. In recognition of the properties of the periodontal soft tissues as barriers separating oral sepsis from the assepsis of the healthy periodontium, the periodontist must establish diagnostic aids that allow us to localize changes that can't be visualized and are asymptomatic for the most part. Our basis of measurement, both of which have intrinsic limitations relating to the definition of early osseous degeneration, are generally dependable for larger disparities. Some periodontists direct much attention toward the tabulation of probing results, in spite of obvious practical limitations. It is necessary to consider the size and shape of the probe, the angle with which it is introduced into the sulcus and the force used to enter the lesion, since all of these individually or collectively, could alter the measurement. Others denigrate radiographs as not being standardized, when frequently they are more interchangeable than probing records. Assuming both to be important to the analysis of the lesion, why not coordinate the two measurements: introducing probes into the deep lesions before making the radiographs (Fig. 1).

The radiographs should be taken with the paralleling technique. The Kvp should be variable from 70-90 for reasons of proper penetration and image clarity. Radiographs provide us with invaluable information relative to the clinical crown/root ratio and the interproximal heights of the alveolar process. It is possible for a tooth to be in periodontal jeopardy because of root resorption or loss of supporting bone and both can be described as an inadequacy of clinical root (Fig. 2). However, the periodontist must recognize the radiograph as a two dimensional reduction of the three-dimensional periodontium and tooth. Although the radiograph and probe frequently sketch a lesion, there is little reason to anticipate a total visage of the defect until one has had the opportunity to visualize the bony topography with the flaps reflected and all granulation tissue removed. It is only at that time that the clinician can correlate the data and arrive at a definite therapeutic conclusion for
the problem at hand.

Common exceptions to primary surgical exposure of an osseous defect are those lesions that are relevant to malposed teeth and combined peri-endo lesions of endodontic etiology. Many malposed teeth with periodontal aberrations have evidenced remarkable improvement during orthodontic intervention. The relevancy of the interproximal crest and its mesiodistal relationship to the cementoenamel junctions of approximating teeth is well known. The crest is parallel to a line connecting the cementoenamel junctions of two approximating teeth. The periodontal literature has noted the apparent radiographic correction of hemisepares, specifically on the mesial surface of mesially inclined mandibular molars, as a result of orthodontic uprighting procedures. It is prudent to describe these aberrations primarily as lesions of tooth position with the superimposition of the inflammatory lesion, when present. Also it is necessary to hold surgical therapy in abeyance until the proper tooth position is achieved, and to evaluate the defect at that time. It would be questionable therapy to perform an osteotomy to eliminate a hemiseptum that might be corrected with improved tooth position, and, thus, obviate the need to remove bone from an approximating tooth.

There are many examples of apparent repair as a result of orthodontic intervention that did not agree with clinical probing or surgical exposure. The clinician must realize that it is possible to mask a proximal defect by superimposing the buccal wall onto the lingual wall. Therefore, it is important to correlate radiographic and clinical information before reaching a conclusion. There is general agreement in the periodontal-orthodontic community that thorough root planing and curettage are valuable entities before and during the orthodontic exercises.

Inflammatory lesions of endodontic origin may fistulate via the marginal periodontium resulting in the precipitous loss of alveolar supporting bone. It is necessary to collate the dental history, the radiograph (often with a tracer), and the clinical probing to further the diagnosis. Pulp testing via sensitivity to percussion, thermal change, and electric testing are used for confirmation. Many deep, tortuous periodontal lesions are dramatically reversed with endodontic treatment of acute pulpal problems, again obviating the need for periodontal surgery (Fig. 2).

The radiograph is essentially a periodontal diagnostic aid to measure the level of the interproximal and interradicular alveolar crest. Frequently there are limitations in its depiction of radicular bone, although halos of bone loss are obvious when the palatal plate or heavy lingual plates have been adversely affected.

Meaningful probing of a lesion must locate an accurate depth. The most common periodontal lesion is the interproximal crater that is bordered by a buccal and lingual wall of bone and the surfaces of approximating teeth on the proximal. It is frequently overlooked in properly positioned radiographs because the buccal and lingual walls of the defect are superimposed on each other. If one probes such an area at the line angle rather than beneath the contact point, it is likely that the lesion...
would be misinterpreted, and, perhaps, corrective therapy not initiated. It is necessary, therefore, to introduce the probe directly under the contact point to accurately measure interproximal damage. Some osseous cysts follow unexpected paths that are only marginally traced with a periodontal probe unless local anesthetia is introduced.

The routine classification of osseous defects is misleading to the neophyte who anticipates the discovery of clearly delineated one, two and three-wall lesions. In truth, visualization results in some combination of the aforementioned and obviates the likelihood of a recipe for a particular defect. The terms “contained” and “non-contained” probably will be more descriptive of the clinical dilemma confronting the periodontist when the soft tissues are reflected and the osseous defect has been debrided. The fresh extraction wound of a non-periodontally involved tooth would be considered the most contained osseous defect because the void would be completely surrounded by bone. There would be an atmosphere of bone regeneration and the clinician could anticipate the repair of the space without adding any element to encourage or initiate this result.

Teeth with a poor periodontal prognosis may be sacrificed in the anticipation of osseous repair. The “strategic extraction” often has resulted in a more favorable prognosis for adjacent teeth. This procedure may be applicable for a range of problems including an impacted mandibular molar, an erupted tooth with advanced periodontal disease, or perhaps one root of a multi-rooted tooth (Fig. 4, 5, 6).

The next most commonly contained lesions are the multi-wall defects. It is necessary to evaluate these lesions carefully for a variety of reasons:

1. They frequently have a more coronal position that has less containment.
2. They generally have this morphology at their most apical extent.
3. They vary greatly in size. Those that are narrow and deep appear to respond more favorably to Prichard’s Intrabony Technique. 5, 6, 7, 8
4. They appear to respond nicely when located on the distal surface of mandibular molars.

Based on information from positive bone graft results, many clinicians have debated as to whether the defect would or would not have fared better if allowed to respond “by itself.” The variety of morphologic patterns and the individual clinician’s own data banks have contributed to the diversity of approaches.

Therefore, one and two-walled lesions must be considered separately. They do not seem to respond as predictably when there is no implant material. The periodontal literature contains many examples of available correction techniques through the use of bone grafts, some of which will be discussed later in this manuscript.

There is little question that excellent access is a necessity for the removal of infected granulation tissue for the thorough debridement of the root surfaces encompassing the defect.

Figure 2B: The left mandibular lateral incisor has lost alveolar support on the buccal and distal surfaces to the level of the apex. Clinical root is no longer present on these surfaces and the prognosis for this tooth is poor. Direction should be diverted to the preservation of alveolar support on the mesial surface of the cusp.

Figure 3B: The radiographic appearance one year later evidences dramatic repair of the interproximal crest of alveolar bone (arrow) between the cuspid and lateral incisor. The first bicuspid, unfortunately, became non-vital and required endodontic attention. (Radiographs supplied by Dr. Jan Rozan, Salem, Massachusetts.)
Let us first consider those procedures available to gain access to the lesion to be diagnosed. It would seem appropriate to select a soft tissue procedure that would allow the clinician thorough and efficient access in order to visualize and treat the problem. The flap procedures that provide limited access to bone, ENAP and Widman, should be avoided in favor of flap procedures with a greater degree of reflection.

Before deciding upon subtraction or addition of bone as the desired therapy, the defect must be properly prepared. The preparation of the defect may be performed readily at the mouth of the lesion and also in those areas where the instrument can fit readily into place. A narrow, tortuous lesion, in fact, "the narrow three-waller," is very difficult to instrument, particularly in posterior interproximal lesions. In fact, the most apical extent of almost all lesions is difficult to reach, even with excellent access. The goals of debridement are categorized as follows:

1. Elimination of all infected granulation tissue from the osseous lesion.
2. Preparation of the inner osseous surface of the lesion.
3. Preparation of the root surface.

It stands to reason that it is necessary to remove all of the infected granulation tissue so as to be able to visualize and prepare the root and the osseous wall (Fig. 7c). It also would appear necessary to eliminate the diseased tissues before anticipating the regeneration of healthy tissue. Chronic lesions are generally lined with "hard wood" cortical bone. Does the cleftlike plate lining of such lesions influence the healing potential? Does it separate the potential resource of pleuripotential cells of cancellous bone from the surface of the lesion? Should decontamination be routinely performed? Some say no, some say only with hand instruments, and others are strenuous advocates. It may be difficult to be sure that decontamination is achieved. In addition, it may be possible that there are enough communications without mechanical penetration. Sometimes the opportunity to implement this step is greatly limited by the lack of mechanical access with a rotary instrument. Furthermore, the strength of the osseous wall makes a hand instrument ineffective. Again, the clinician must resort to individual consideration.

There are opportunities to treat acute lesions of periodontal origin. These lesions are generally thought to have an increased capability for a recuperative response. A factor to consider is that the cortical plate of such osseous lesions probably has not had time to reorganize and there may be direct communication with the pleuripotential cells of the underlying cancellous bone.

How best to prepare the exposed root surface? All agree with the obvious removal of visible accretions, but disagreement arises over whether the root surface should be strenuously planed, so as to remove all cementum, and whether the clinician can identify this goal at the level of desired tissue reattachment. It is possible that the routine strenuous root planing results in a tooth surface that is predominately denin. It is necessary for the dentin surface to develop a cover of cementum as part of the
This new cementum is described as secondary or cellular cementum, since its relatively rapid maturation incorporates cementoblasts within the matrix structure. It also incorporates connective tissue fibers (Sharpey’s fibers) that are part of the fibrillar complex of the periodontal ligament.

Must the clinician consider the same limitations for elimination of endotoxin from root surfaces or be satisfied with the removal of visible accretions? It is not presently within the clinician’s diagnostic acumen to be able to identify the final elimination of endotoxin from the root surface. Is there a benefit from chemical therapeutic agents, such as hydrochloric acid, which has been shown to be effective in reducing the bacterial count in root canals.

Can citric acid maintain a pH of 7.4? The use of citric acid may or may not be a practical or necessary adjunct to achieve in the preparation of an osseous lesion for a reattachment procedure. The fact that it may not be necessary has been substantiated by the preponderance of successful case reports with a variety of grafting techniques without the introduction of citric acid.

After having achieved the opening procedures and having accomplished the debridement of the lesion, the root surface, and the preparation of the osseous walls, how does the clinician proceed? At this time, it is necessary to evaluate the lesion as it relates to the dentition as a whole. Is it necessary to attempt to regenerate the missing alveolar support? The problem concerns the treatment of a stable tooth with a minor interdental crater; the addition achieved may not be significant. It is important to have a lucid appreciation of the predictability of pocket elimination with minor osteotomy to attain an acceptable osseous architecture before committing a tooth to an addition procedure.

Procedures for increasing the alveolar support for a tooth are unquestionably valid when their success will obviate the need for tooth replacement therapy and when they will change the status of an untenable strategic abutment to manageable. Many other considerations, such as the esthetics, are clearly of value. Yet it is necessary to consider the small reattachment achieved when a 1.5 mm root of a bicuspid is treated for 2 mm deep intracoronal lesion. Even if it is 6 mm in width, the resulting 12 mm of new connective tissue attachment will be a very small percentage of the total alveolar support for this tooth and will not likely influence the prognosis of the tooth in question. This is particularly valid when considering an addition procedure for an abutment tooth for a fixed prosthesis. The clinician must remain cognizant of both the healing time required for a bone graft and the observation that a grafted site may not result in one hundred percent healing. It is routine to wait at least four to six months before contemplating the success of a bone graft.

It will definitely delay the restorative procedures and may adversely influence the progress of therapy. In spite of this, abutment teeth with osseous lesions that predispose to addition procedures that would significantly improve their prognosis are obvious candidates.
There is a preconceived opinion that a bone graft must either succeed or fail. It is important to realize that many grafts result in less than complete regeneration, but effectively resolve an inoperable lesion. The correction has converted an unmanageable tooth to a realistic abutment in spite of an obvious small residual lesion. This then requires the site to be re-oriented so that the residual lesion could be resolved before continuing with the restorative treatment plan. Thus, completion of the case is further delayed. This certainly should be taken into consideration when anticipating regenerative osseous therapy for an intermediary non-strategic tooth for a large fixed bridge.

Assuming the defect has been properly prepared for evaluation and the decision is made to seek reattachment, what methods are available and what goals are realistic? There are a number of publications that demonstrate histologically the new development of the entire connective tissue apparatus, including the neurovascular process, the periodontal ligament and a new secondary cementum, when studying human block sections.19-21

There is a preponderance of information available that demonstrates the repair after a period of months or years. There are conceivable explanations for those histologic sections showing a long epithelial attachment in lieu of a connective tissue attachment, but a clinician should no longer assume that connective tissue reattachment is impossible.22 If the premise is true that a bone graft can succeed clinically and histologically, then clinicians must turn their attention to the methodology of achieving the result.

Most periodontal osseous defects offer a morphologic combination, i.e., proceeding more contained at their base and less so at their portal of entry. It is frequently reasonable to do some subtraction therapy of the uncontained portion and then use an addition procedure for the more predictable, contained portion of the lesion, when subtraction of bone would not jeopardize the prognosis of adjacent teeth.

The evaluations of materials available for repair of osseous lesions have grown appreciably since the first report by Naehers.23-24 Success has been reported with the utilization of intraoral bone, extraoral bone (iliac crest), allografts, and perhaps even synthetic materials, resorbable and non-resorbable. The obvious first consideration is whether the properly prepared lesion may respond to a self-fill procedure.25-27 The preponderance of positive results seems to have been found on more deeply contained lesions, particularly on the distal surface of mandibular molars and the lingual surface of mandibular bicuspidis. Many other deep contained lesions appear to have the potential for some repair with this therapy, but the clinician may find an enhancement of the predictability of the results when an osteogenic material is put into the osseous defect.

Let us next consider the intraoral harvesting of donor bone. Early successful case reports used bone from the immediate area, sometimes from the uncontained portion of the defect.23-24 Later reports included bone from the maxillary tuberosity, when the sinus per-
mitted, the mandibular retromolar area, recent extraction sites and various combinations so as to increase the number of harvestable areas. The manner with which sutured areas are harvested can influence the yield. As an example, a fine, non-glueing suture may damage some bone, and, thus, produce a lesser yield than a properly designed suture. An insufficient quantity may be enhanced with allogenic bone and the ensuing coagulum may satisfy the needs. Although the original use of the term coagulum described the collection of autogenous particles, contemporary terminology includes combinations of autogenous bone, allogenic bone and sometimes artificial substances. This is certainly a consideration when treating large or multiple lesions. If possible, the use of autogenous intraoral bone appears to offer both successful results clinically and the ease of patient management. The particles of bone are collected in a sterile dappen dish and transferred to the osseous defect in small quantities. The squares are compressed into the defect with the firm use of an amalgam plugger to approximately eliminate the defect. Many clinicians seek to limit themselves to cancellous bone when harvesting intraoral bone, but there are times when this proves impossible due to yield quantity or difficulty in clearly delineating the difference.

Another form of intraoral osseous graft is the contiguous autogenous graft, a "green stick" fracture (Fig. 8). There are limited applications of its use because of its dependency upon both the morphology and location of the osseous defect. It generally is performed more readily for maxillary lesions because of the presence of incisor and cancellous bone, but it is applicable for proximal lesions adjacent to edentulous saddles and proximal osseous defects found in wide embrasure areas. The advantage of this technique is that the continuity of the blood supply is maintained in the stalk as the green stick fracture is created. It is necessary to make the initial break in the bone a significant distance, at least 5 mm, from the tip of the lesion, to lessen the possibility of separating the bone from its base as it is moved and, thus, lose the continuity.

If there is a paucity of intraoral bone and the clinician prefers to perform an autogenous graft, the iliac crest should be considered as a donor site. This is especially true in decimated dentitions with multiple lesions (Fig. 9). There have been some case reports in which the marrow was harvested and immediately delivered to the periodontal lesion. This is generally not possible, so the most common method involves freezing the material for a number of days before initiating its use. Root resorption was reported in a small number of cases of fresh marrow, but has not appeared as a problem with the frozen technique. Schallhorn, Dragoo, and Haist have demonstrated dramatic results with this material. An obstacle to the utilization of this technique is the need for a patient's consent. Many people realize the potential benefit and readily agree, but there are "takers.

The use of allogenic bone has proven effective for a wide panorama of defects. Bowers, et
al. have demonstrated that freeze-dried cadaver bone is readily available and easy to hydrate and apply to a lesion. Contrary to earlier uneasiness, long range results appear to be indistinguishable from previously described techniques. It is certainly a valuable aid as a supplement for inadequate harvests of autogenous bone. An amalgam carrier can be a valuable aid in transporting this material from the sterile dappan dish to the osseous defect because of the fine consistency. The packing action can proceed in the same fashion as used previously for the other modalities.

Synthetic bone grafting materials are defined as alloplastic. There are two general categories, resorbable and non-resorbable.

The resorbable material (example: Synthograft) is a (beta) tricalcium phosphate ceramic. It theoretically works by being engulfed and dissolved by blood cells as new bone develops.*

The non-resorbable materials (Periograft) are durapatite particulate ceramic mesh (Fig. 10). This material is a polycrystalline form of hydroxyapatite, the major mineral component of bone. It is theorized that new bone is deposited on the surface of the durapatite.**

Since the graft material does not resorb, the clinician must question the type of interface that develops between the root surface and the bone graft site. Whether a true connective tissue attachment forms or a long epithelial attachment develops has yet to be histologically demonstrated.†

The full potential of creating a new attachment is, hopefully, in its infancy. Great strides have been taken by clinicians who were willing to accept others' skepticism and had confidence in their quest to accomplish results previously considered unattainable. The surprising dilemma is that many practicing dentists relate negativity to bone regenerative techniques in spite of the collective evidence of success. Many failures relate to site selection; others relate to the inadequacy of access to the lesion, the incomplete debridement of granulation tissue, and proper root preparation. Others relate to factors that are not clearly explained. But it is impossible to assume the posture that the establishment of a new attachment apparatus in the form of new cementum, periodontal ligament, and alveolar process is not possible. Too many successes, by too many therapists treating diversified lesions, are available for review.‡

The challenge for tomorrow is to hone in on the variables and try to improve predictability in cross-matching lesions and donor materials. In the interim, therapy must be provided for patients with tooth-threatening lesions. Negative thinking should be replaced with careful documentation and observation of results.

* Synthograft product description syllabus
** Periograft product description syllabus
† Synthograft product description syllabus
‡ Periograft product description syllabus

Figure 8A: Autogenous bone grafting techniques may function not only to rebuild lost periodontium for esthetic achievement, but also obviate the need for tooth replacement dentistry. Note the osseous defects on the mesial surfaces of the mandibular first molar and second premolar. Although the most apical extensions of the lesion are contained, the more coronal portions definitely are not. The grafting material was harvested from the posterior iliac crest.
Figure 9B: The reopening procedure 8 months later. Osseous regeneration is obvious although some residual defect is found on the mesial surface of the second bicuspid.

Figure 9C: The lingual view of Fig. 8a. Note the continuation of the proximal defects onto the lingual surface.

Figure 9D: The lingual view at the time of reopening. Note the osseous regeneration at the mesial line angle of the second bicuspid and interproximally between the second bicuspid and first molar, as well as, the repair of the lingual lesions.

Figure 10A: A maxillary cuspid that is categorized as a strategic abutment. An older unsuccessful maxillary fixed bridge is being replaced. There is a deep mesial lesion involving the cuspid (arrow).

Figure 10B: A new radiograph taken 9 months after periodontal therapy. A synthetic graft has been utilized in an effort to re-capture lost periodontium. A non-resorbable material has been used with apparent radiographic success and appears to show considerable improvement.

Figure 10C: The clinical view of the osseous defect at the time of surgery (arrow).
References


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