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ORAL SURGERY

Current Concepts In Periapical Surgery

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With the introduction of surgical techniques and the recently accepted high success rates for dental implants, the indications and contraindications for periapical surgery should be reevaluated.

Periapical surgery as an adjunct to endodontic treatment is a proven technique. The key word here is adjunct because without proper debridement of the intracanal area, the resultant periapical surgical intervention will be compromised.

Whitehouse in 1884 had stated, "A few moments' consideration of the original cause of trouble at the apex of roots will enable us to realize what is required to be accomplished in the way of successful treatment. If the original cause is admitted to be irritation from decomposing pulp, its removal will in most cases effect a cure."[1]

Even today, methods do not exist to thoroughly eliminate all intracanal debris and microorganisms, and materials to establish a hermetic apical seal still elude our grasp.[2]

The overall success rate for periapical surgery has been reported to range from 46% to 92%.[3-5] Achieving higher success rates may be possible through the use of some current methods, as described below.

RADIOGRAPHIC EVALUATION

Prior to periapical surgery, two periapical radiographs should be taken from different angles to detect the presence of fractures. When a fracture appears on both views and moves consistently with the movement of the X-ray beam, this most likely indicates the presence of a fracture. However the appearance of trabecular bone patterns, especially in the maxilla, may mimic this finding. By taking the second X-ray one frequently finds that the fracture noted on the first film is an artifact. This is frequently noted in the maxillary cuspid and the first bicuspid area where the palatal root of a first bicuspid may easily be misdiagnosed as an oblique fracture through the cuspid. A vertical periapical of the cuspid and a horizontal view of the first bicuspid should be taken when treating either tooth. Different angle radiographs may also reveal the presence of adequate or inadequate condensation of the root canal material. The presence of accessory, lateral, or secondary canals may also become evident when changing the angle of the radiographs.

A panoramic survey is recommended when evaluating the premaxilla and posterior maxilla to assess the proximity of the nasal cavity and maxillary sinus respectively. In the posterior mandible, visualization of the inferior alveolar canal is often misrepresented when methods are used other than a well-taken panoramic study.

The apex of a root is rarely in direct contact with the inferior alveolar nerve or even below it. Certainly these are cases where surgical intervention must be weighed against re-treatment or removing the tooth. Without adequate radiographic visualization some of the above mentioned conditions may not be detected. Panoramic evaluation of the position of the inferior alveolar nerve often shows that the risk of postoperative altered sensation (anesthesia, paresthesia, dysesthesia) is less likely to occur. Patients are frequently told that without a panoramic survey, the risk of sensory loss is a contraindication to performing apical surgery on mandibular posterior bicuspids or molars even though the probability of this occurring is minimal. The periapical X-ray often depicts the position of the canal as being closer than it is. Also a periapical X-ray may lead to the incorrect assumption that the mylohyoid line is the upper indication of the canal. A panoramic view will show this same finding to be a

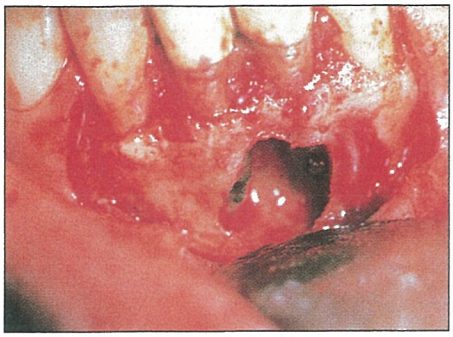

Fig 1.—Large periapical area treated three times unsuccessfully (over a period of 20 years) with apical surgery alone.

Fig 2.—Placement of a GTAM membrane. Note that the inner portion of the membrane covers the defect and the outer portion of the membrane rests on the intact bone.

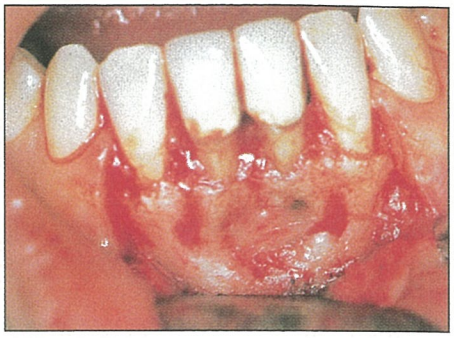

Fig 3.—Six-months postoperative result showing osseous regeneration.

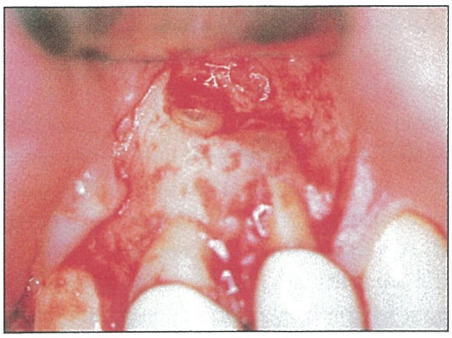

Fig 4.—Root dehiscence along tooth No. 10.

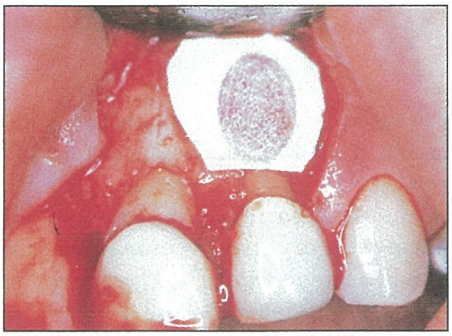

Fig 5.—Placement of a GTAM membrane.

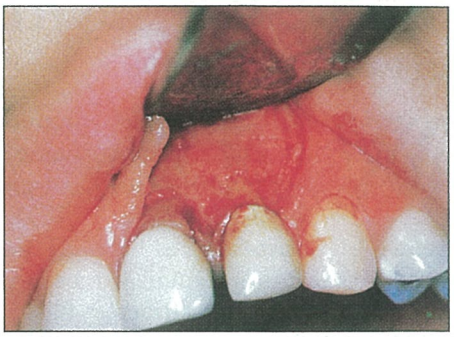

Fig 6.—Complete regeneration of a buccal alveolus.

separate anatomical structure, because visualization of the area is complete in all directions. The risk of altered sensation, paresthesia, or dysesthesia after apical surgery is extremely rare. This postoperative complication is more likely because of poor flap design and retraction techniques, not the position of the root apex and its proximity to the inferior alveolar nerve. Apical surgery in the posterior mandible should be performed by practitioners well versed in surgical anatomy of this area.

CLINICAL EVALUATION

A clinical checklist should be done prior to periapical surgery. This includes but is not limited to:

1. A thorough history of the problem. The finding of a periapical area in an endodontically treated tooth does not indicate the need for periapical surgery. (See absolute and relative indications for periapical surgery). Radiographic radiolucency may represent incomplete nonpathological healing, normal anatomy, or an area that is healing and was at one time larger than its present size.

A recent history of an upper respiratory tract infection frequently leads to a diagnosis of a posterior maxillary dental problem, when a persistent sinusitis must be ruled out first. Frequently the patient presents with pain in more than one tooth from the maxillary bicuspids and back. Radiographically, a panoramic view will show a mild opacity or cloudy appearance on one or both sides. Any questionable areas of concern (ie, existing periapical areas or perio-endo defects) may be the cause of the maxillary sinusitis, especially if it is unilateral. Many apparent sinus conditions should be fully evaluated to rule out dental etiology.

Whenever evaluating maxillofacial pain with or without a dento-alveolar component, rule out sinus etiology before performing any surgical procedure. With CT and MRI scanning, otherwise undetected pathology can be diagnosed before surgical intervention.

2. Pulp testing the adjacent teeth

3. Checking for traumatic occlusion.

4. Isolating each tooth in the quadrant and opposing quadrant to biting pressure and percussion.

5. Isolating each tooth, as best as possible, in the quadrant and opposing quadrant to hot and cold sensitivity.

6. Determine probing depth circumferentially to rule out a perio-endo defect. If such a defect is deter-

mined preoperatively, ie pocket depths extending to a furcation or even to the apex, then apical surgery has a low prognosis for success. If however there is an intact and healthy periodontium, even in the presence of a large area or an area extending along the side of a root, then this may be an endo-perio defect or apicomarginal defect. Treatment for this defect has recently been described.[8]

7. Evaluating the integrity of the existing restoration. If a crown is present that will eventually be replaced,[12] then prior to periapical surgery the crown should be removed and replaced with a provisional restoration. Once this is done, the presence of a coronal fracture may be detected, and the tooth in question can be removed if it is not restorable. Radiographically this may be seen as a widening of the lamina dura if the fracture extends apically.

Evaluating previous radiographs may also be helpful because they will most likely be negative for showing a developing problem at the apex. Therefore, when there is a widened lamina dura or an area that is lateral to the root especially adjacent to a post, and this radiolucency is a more acutely developing problem, then it most likely represents a fractured root. Also, when preparing for the provisional restoration one may find that the clinical crown height is inadequate. A crown-lengthening procedure needs to be performed at the same time as the periapical procedure. If this is determined prior to the surgical intervention, then the patient benefits from not having multiple procedures performed at different times.

The sequence of procedures should be crown lengthening first to determine if the final crown/root ratio is prosthetically acceptable. If it is, then the periapical procedure is performed during the same surgical visit. If the tooth in question is nonrestorable prosthetically (unacceptable crown/root ratio, or excessive mobility), then remove it rather than performing a surgical procedure with a poor prognosis.[9]

By following this simple protocol, many apicoectomies that would have resulted in re-treatment and eventual failure will not be done initially. If the crown needs to be replaced, then it should be removed and replaced with a provisional as a routine procedure only if the treating practitioner did not perform the root canal, or prepare and cement the post and crown. Preparing this provisional will serve both a functional and diagnostic role. This can prevent and save a lot of expense, time, and unnecessary surgery.

IMPROVED TECHNOLOGY AND TECHNIQUES

In addition to adhering to the above guidelines, the following surgical techniques and improvements have also caused success rates to improve significantly.

Fiber optics

Fiber optic use within a surgical handpiece and as an external source have greatly improved visualization of the operating field. Fiber optics can also be useful to transilluminate the maxillary antrum thereby improving identification of anatomical landmarks (ie antral floor) and identifying the palatal root of maxillary bicuspids and molars, when taking a buccal approach with bicuspids and a transantral approach with maxillary molars.

The introduction of the operating microscope

Anything that greatly improves the visualization of the operating field can only result in better identification and detection of problems and their correction. Not all problems are correctable, however there is a much better chance of fixing a problem if it is detected early. The operating microscope improves the probability of finding an otherwise undetected problem. If the etiology of a problem is a fracture that would not have been detected without the microscope, then the surgical procedure may be aborted without further useless surgical intervention.

Microsurgical instruments

Small instruments, such as microsurgical mirrors, miniaturized explorers, condensers, scalpels, and reverse preparation instruments are all appropriate when higher magnification is used.

Ultrasonic retro-preparation

This may be the single most significant improvement in recent years. The advantages include direct preparation into the canal, ultrasonic debridement of the canal and surrounding tissue, less tooth reduction because the angle of the bevel is reduced due to the angulation of the surgical ultrasonic tip, thereby maintaining a more favorable crown/root ratio. Ultrasonic retro-preparation also enables a more ideal hermitic seal by preparing the canal to a point below the surgical bevel. This results in limited dentinal tubule exposure to the prepared ultrasonic area. This theoretically results in less intracanal microleakage through dentinal tubules that would occur, when a long surgical bevel is made, exposing more dentinal tubules, and a shallow retropreparation is prepared in rotary retropreparation cases. Another advantage of ultrasonic retropreparation is the oscillations it causes within the canal, which may reveal a fracture.

Since an undetected fracture is probably the most common cause of failure when performing periapical surgery, we now have two diagnostic methods to evaluate the presence of a fracture. Radiographically we look for the presence of a widened lamina dura, an area that extends from the apex coronally to the area where the post meets the root canal material, or an area that does not seem associated with the apex at all and is lateral to the root. On careful examination an accessory canal or extruded filling material may be seen going from the main root canal fill to this lateral area, indicating that this is anatomical and not a fracture.

PROPER VISUALIZATION OF THE SURGICAL SITE

The approach utilizing the semilunar incision is often used to preserve the periodontal attachment. However this approach may result in a misdiagnosis of the problem if there is a periodontal component to the pathology as well as not allowing for adequate access to properly debride the area. If there is a complete loss of buccal alveolus (apicomarginal defect) then the ability to visualize, debride, and treat this condition is severely compromised with the semilunar design.

An ideal flap design for apical surgery is best developed with a full-thickness mucoperiosteal design over the tooth with a vertical release on one adjacent tooth. In the anterior region the adjacent tooth is usually distal, whereas in the posterior region the vertical release is usually mesial. The interdental papillae of the second adjacent tooth is kept intact. This allows excellent exposure of the field and gives the surgeon all available options depending on the etiology of the problem.

Guided Tissue Regeneration (GTR)

The use of guided tissue regeneration is recommended when a complete apicomarginal defect is noted at the time of surgery. This defect can be defined as a complete loss of buccal alveolus extending from what was once crestal bone to the apex of the tooth. One study reported, 37% success rate has been reported in the presence of this defect,[6]

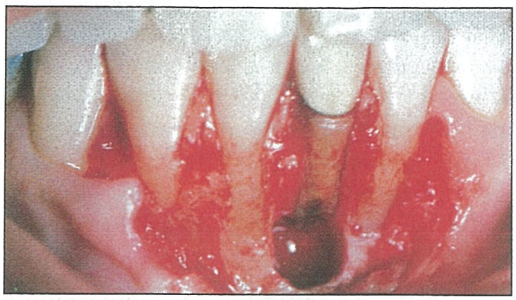

Fig 7.—Complete apicomarginal defect of tooth No. 24. The defect extends from what was once crestal bone to the apex of the tooth.

Fig 8.—Regeneration of a buccal alveolus after the GTAM membrane is removed.

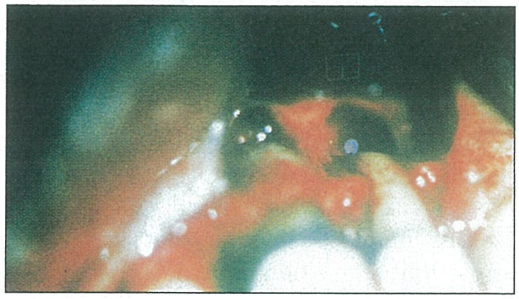

Fig 9.—Complete apicomarginal defect on tooth No. 10.

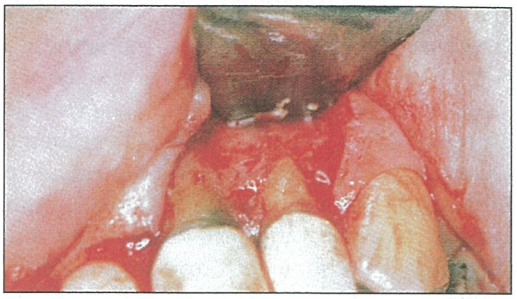

Fig 10.—Significant regeneration resulted when a GTAM membrane was utilized and then removed after 6 months.

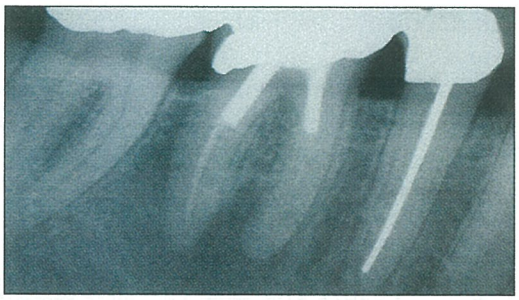

Fig 11.—Preoperative radiograph showing periapical area. Note the distal of No. 3. Radiographically, you cannot determine if an apicomarginal defect exists, but there is a strong suspicion here.

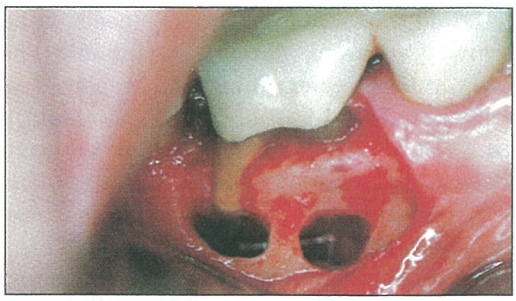

Fig 12.—Clinical photo showing a complete apicomarginal defect. After thoroughly debriding the area, a GTAM membrane is positioned.

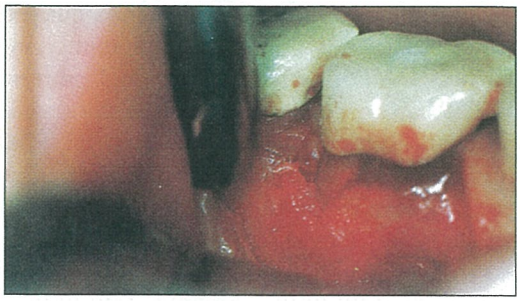

Fig 13.—After 6 months, the membrane is removed, showing regeneration of a buccal alveolus.

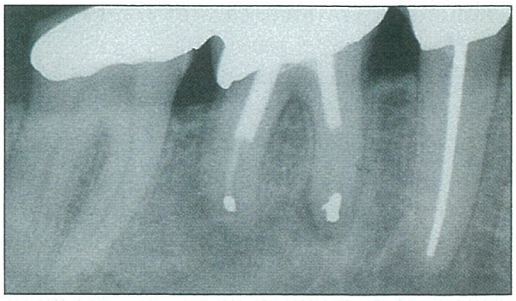

Fig 14.—Follow-up radiograph after 1 year. Note the osseous fill on the distal of No. 30. Without the clinical appearance shown in Fig 13, there is no way to know that this alveolus has regenerated on the buccal surface of the root. However, this follow-up radiograph is suggestive of a regeneration.

while a different study found a success rate of only 27% when complete loss of buccal plate was noted at surgery.[7] The presence of apicomarginal defects will significantly decrease the success rate for periapical surgery when this category is included in overall statistical analysis. The determined success rate was to be evaluated by postoperative radiographic analysis. It is not theoretically possible to determine buccal osseous regeneration on the basis of a periapical radiograph, and their success rates may be lower than indicated. What we have learned from these two studies is that without GTR, the prognosis for successful regeneration of a buccal alveolus is minimal, when an apicomarginal defect is detected. The use of GTR alone may result in complete osseous regeneration both clinically and radiographically.[8] The four cases included show the preoperative and postoperative results of this approach (Figs 1 through 14).

INDICATIONS FOR GTR

The indication to use guided tissue regeneration or guided tissue augmentation material (W.G. Gore Co.) is in the presence of a complete loss of buccal alveolus. The practitioner should suspect the possibility of an apicomarginal defect when a fistulous tract is at or near the muco-gingival junction. The more incisal the fistula is located, the more likely an apicomarginal defect will be encountered. With isolated inflammation in the buccal area, the destruction of the periodontium has usually occurred secondary to the endodontic lesion and has developed over time. More erythema may be noted in the keratinized tissue overlying the area in question when compared to the adjacent similar tissue. Thinning of the mucosa may occur over the buccal aspect of the root with or without palpable root structure. Also, there may be radiographic evidence of a periapical lesion that is continuous with the lateral aspect of the root and associated loss or widening of the lamina dura.

Any or all of these findings may also be consistent with the presence of a vertical fracture. Exploratory surgery must be diligently performed to rule out the presence of a fracture. However, when a fracture is not evident it may indeed be present and eventually result in a failure, requiring the removal of the tooth.[8]

CONTRAINDICATIONS FOR GTR

GTR is absolutely contraindicated with periapical surgery when a vertical fracture is noted, or if a medical condition would negate performing surgery.

Relative contraindications for GTR with periapical surgery are more varied. The first sign is the presence of long-standing periodontal disease with associated alveolar bone loss preceding a periapical defect. When the adjacent area to the tooth with the defect presents with severe horizontal or vertical bone loss approaching the level of the periapical area, then repair is not recommended.[8] If a poor crown/root ratio exists, and there is available bone apical to the existing root apex to result in an improved crown to implant ratio, then alternative surgical options should be considered.[8,9] These may include bone grafting followed by a single-unit implant or simultaneous extraction and implant placement along with bone grafting with or without a membrane. The restorative option of a three-unit fixed prosthesis must always be considered. If it is decided that the tooth will be removed, ridge augmentation should be considered to create a more ideal prosthetic environment thereby eliminating the need for a ridge lap.

ABSOLUTE INDICATIONS FOR PERIAPICAL SURGERY

If a male patient with a history of prostate or lung cancer presents with a questionable periapical area that is increasing in size and has been adequately treated nonsurgically, a biopsy of the periapical tissue is indicated to rule out metastatic disease. If a female patient has a history of breast or lung cancer and a questionable area, that is also increasing in size and has been appropriately treated nonsurgically, a biopsy of the periapical tissue is indicated for the same reason. These are the most common primary sites that can metastasize to the maxillofacial area. A bone scan may also be performed for other possible metastatic sites but this does not negate the fact that the area in question may be one of many sites or an isolated area.

Sometimes it is not possible to reach the area of pathosis and remove the causative agents. Access may not be available through the root canal system with routine debridement, extirpation, and obturation of pathological intracanal tissue.

RELATIVE INDICATIONS FOR PERIAPICAL SURGERY

Surgery is indicated when the following signs and symptoms of pain, swelling, and /or increasing size of periapical pathology are present:

1. Excess extension of root canal material through the apex.
2. A separated instrument at or through the apex.
3. A perforation through the lateral aspect at curvature of the root.
4. A calcified canal with incomplete fill.
5. Severely curved nonnegotiable root apex.
6. Traumatic fracture of the apical one third of the root with an inability to endodontically negotiate apical to the fracture.
7. An apical resorptive process treated unsuccessfully using nonsurgical approach.
8. The post and crown are permanently cemented (if the removal of either may damage or destroy the structural integrity of the tooth).
9. A wide open apex where attempts to seal are unsuccessful from the intracanal approach, especially in the presence of a necrotic pulp and apical lesions.
10. Development of a radiolucency when there was none previously and

attempts at re-treatment are not successful.

11. Removal of necrotic cementum.

12. Removal of external resorptive processes.

ABSOLUTE CONTRAINDICATIONS FOR PERIAPICAL SURGERY

Surgery should not be performed under the followingconditions.[10,11]

1. When the general health of the patient would be jeopardized, such as untreatable thrombocytopenia or recent myocardial infarction.

2. Teeth with severe periodontal disease and exhibiting excessive mobility.

3. Inaccessible teeth and apices.

4. Teeth requiring too much root structure and/or bone be removed, so the crown/root ratio would be so altered that the tooth would exfoliate itself as a result of the periapical procedure.

5. When traumatic occlusion cannot be corrected.

6. Teeth that have been treated previously by several apicoectomies, and the root canal system is not properly filled. (Here endodontic re-treatment is indicated first and then the tooth is reevaluated for the need for periapical surgery).

7. To correct poor nonsurgical endodontic treatment that can easily be treated by routine endodontic care.

POSSIBLE CONTRAINDICATIONS FOR PERIAPICAL SURGERY

Periapical surgery is not indicated for some systemic preexisting conditions[10,11] including but not limited to: radiation therapy to the area, osteoradionecrosis history, prolonged corticosteroid use, brittle diabetes mellitus, idiopathic thrombocytopenic purpura, required prophylactic antibiotics, polymyositis, hemophilias, leukemias, lymphomas, plasma cell dyscrasias, AIDS, vasculitides, mixed connective tissue disease, rheumatoid arthritis, chronic active hepatitis, lupus erythematosus, and many malignancies Ehlers-Danlos syndrome, Marfan's syndrome, myasthenia gravis, Munchausen's syndrome, personality disorders, drug dependence history, psychoses, chronic renal failure, immune complex renal diseases, chronic glomerular disease, renal tubular acidosis, Fanconi's syndrome, major organ transplantation, anticoagulant therapy, and chemotherapy. Other contraindications to periapical surgery9,10 include Trigeminal neuralgia, atypical facial pain, history of osteomyelitis, precancerous lesions in operative area, and a noncomplaint patient

MANAGED CARE CONSIDERATIONS

In today's managed care environment, it is too often the case that insurance carriers will deny the re-treatment of a procedure if it occurs within a certain period of time. In this scenario the insurance standards for reimbursement would favor apical surgery and not re-treatment. This is medically unacceptable but is consistent with insurance guidelines. As professionals we should adhere to the principle that what we offer and discuss as options is to the benefit of the patient. This may be in direct conflict with managed care treatment guidelines.

Herein lies a basic difference when it comes to treatment planning from the professional's point of view vs managed care where ideal treatment is the most basic treatment that will cost the least. It is true that some patients will elect to go directly to apical surgery rather than re-treatment as their first choice. The exception here should be when the initial endodontic treatment may be less than ideal. It is the patients' right to have it re-treated without having to incur additional expense because of denied coverage or reimbursement according to insurance time frame guidelines.

Another example of these inappropriate guidelines, as set forth by insurance carriers, is described in the following example. Suppose the patient is given the option of having apical surgery performed with a poor prognosis vs extraction when the adjacent teeth are sound periodontally. Assume that the adjacent teeth are without carious involvement or existing large restorations. Consider the scenario where the prognosis is poor for apical surgery, but this is reimbursable. The only other option is the removal of the tooth and the fabrication of a three-unit fixed prosthesis, whereby the teeth to be prepared are sound. This also is reimbursable. We are assuming that the coverage for a single-tooth implant is denied. Is it not a more radical procedure to prepare intact tooth structure and place a prosthesis over this prepared tissue, than to leave this tooth structure and reconstruct the alveolus and replace the missing tooth with a dental implant? This is a reconstruction in the true sense of the word.

Current concepts favor the implant in this case, and this option must be offered to the patient. Of course, when there are old and large restorations present on the adjacent teeth and full coverage may improve their structural integrity, then a three-unit fixed prosthesis may be the most ideal option. There will always be patients who favor an implant when there is preexisting full coverage on either side of the edentulous space. Conversely other patients will prefer to prepare two perfectly intact teeth in favor of the placement of a single-unit dental implant. The patient should be given all these options in an unbiased manner and not be put into a position whereby they are deciding which treatment to pursue because one is reimbursed and one is not. This is ethically wrong and should be addressed.

All procedures accepted by the American Dental Association should be reimbursable or covered by insurance carriers. For example, an insurance carrier should reimburse a patient what he/she would have paid for the cost of a three-unit fixed prosthesis, if a patient decides to have a dental implant with its asso-

ciated abutment and crown. When considering the overall cost for a three-unit fixed prosthesis, and endodontic treatment is indicated for prosthetic reasons on the adjacent teeth, then not only will the cost be greater (three-unit bridge, two RCT, and two posts and cores), but the procedure to devitalize and prepare intact teeth warrants serious questioning.

The scenario is likely in young patients with a traumatic injury, where one tooth may be avulsed or fractured. In this case the tooth is removed and the adjacent teeth may have large pulp horns requiring endodontic treatment when preparing them for full coverage for a three-unit prosthesis. This may also be the case when teeth are extruded and have an edentulous space between them or opposing them. If an acceptable plane of occlusion cannot be obtained without significant removal of tooth structure which requires endodontic treatment, then some options may be no treatment, significant crown lengthening and endodontic devitalization, removal of the extruded teeth and their prosthetic replacement, or implant reconstruction of the entire area.

I use the term reconstruction because this is what we are accomplishing. Our approach from both the professional point of view and insurance guidelines should focus on a medical viewpoint, whereby dentists should view the single missing tooth to represent a damaged alveolus that has the potential to be reconstructed. The fabrication of a three-unit fixed prosthesis will do nothing to help the damaged alveolus, and atrophy of the edentulous alveolar bone will eventually occur.

This does not imply that every edentulous space should have a dental implant. However, we should reevaluate how we look at the biological event of preparing intact teeth with potential devitalization of adjacent healthy pulp tissue. Compare this to the reconstruction of an edentulous area and the placement of a dental implant thereby restoring form and function.

Eventually insurance companies will realize that although reimbursing or covering the procedure of a three-unit fixed prosthesis (when RCT is not indicated) vs a dental implant may initially less cost, the potential for future endodontic intervention, periodontal breakdown, recurrent decay[12] and the cost to remake the bridge of the same length or longer may ultimately cost more. Approving a dental implant initially may be the most financially cost-efficient and seem to outweigh the financial savages in approving the three-unit fixed prosthesis from the beginning.

Here is a unique example whereby insurance carriers may achieve their goal of being cost efficient, and the patient benefits by not having intact tooth structure removed. Only when this is evident will reimbursement for implants become a covered expense for dental carriers. The problem is that we have to view the consequences of treatment on a long-term basis, and there are no studies to compare cost effectiveness of implant placement vs fixed prosthetic treatment (specifically the single-tooth implant compared to a three-unit fixed prosthesis). The placement of a single-tooth implant is probably the most demanding procedure in implant dentistry. If done correctly the result is a true reconstruction of the alveolus and perseverance of the adjacent periodontium. However, if the procedure to place the implant does not adhere to multiple surgical, periodontal, and prosthetic principles, the results can be iatrogenic as in any endeavor in our profession. Treatment planning and placing the single-tooth implant should not be done by less-experienced providers, although it may appear initially to be less complicated than other implant procedures.

Today, the placement of a dental implant is no more traumatic than the removal of a tooth. It is however a surgical procedure, and as such must be fully evaluated as to its risk vs benefit to the individual. The preparation of teeth is also a surgical procedure with definite irreversible long-term consequences, and it must be fully evaluated as to its risk vs benefit to the individual patient. Obviously, each patient must decide what is best for them after having been given all their options.✦

References

1. Whitehouse W. New mode of treating dead teeth and alveolar abscess. *British J Dent Sci.* 1884;27:238-240.
2. Gutman J, Harrison J. Surgical *Endodontics.* Cambridge, Mass: Blackwell Scientific Publication; 1991:3.
3. Rud J, Andreasen JO, Moller-Jensen JE. A follow-up study of 1,000 cases treated by endodontic surgery. *Int J Oral Surg.* 1972;1:215-228.
4. Middonen M, Kullaa-Middonen A, Kotilainen R. Clinical and radiographic reexamination of apicoectomized teeth. *Oral Surg Oral Med Pathol.* 1983;55:302-306.
5. Sumi Y, Hattori H, Hayashi K, et al. Ultrasonic root-end preparation: clinical and radiographic evaluation of results. *J Oral Maxillofac Surg.* 1996;54:590-593.
6. Skoglund A, Persson G. A follow-up study of apicoectomized teeth with total loss of buccal bone plate. *Oral Surg Oral Med Oral Pathol.* 1985;59:78-81.
7. Hirsch JM, Ahlstrom U, Henricsson PA, et al. *Periapical Surgery. Int J Oral Surg.* 1979;8:173-185.
8. Pompa D. Guided tissue repair of complete buccal dehiscences associated with periapical defects: a clinical retrospective study. *JADA.* 1997;128:989-997.
9. Christensen GJ. When is it best to remove a tooth. *JADA.* 1997:128;635-636.
10. Archer H. *Oral and Maxillofacial Surgery,* Volume One, 5th ed. Philadelphia, Pa: W.B. Saunders Co; 1975.
11. Fonseca R, Davis WH. *Reconstructive Preprosthetic Oral and Maxillofacial Surgery,* 2nd ed. Philadelphia, Pa: W.B. Saunders; 1996.
12. Libby G, Arcuri M, LaVelle W, et al. Longevity of fixed partial dentures. *J Pros Dent.* 1997;78(2):127-131.

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