Exposure of Bone in Periodontal Surgery

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TYPES OF PERIODONTAL SURGERY

Exposure of the alveolar bone is frequently necessary in surgical procedures to correct gingival and vestibular deformities and osseous defects that result from periodontal disease. All procedures are designed therapy involving one or more of the following anatomic areas: the gingiva, vestibular fornix, frenum, fibrous or muscle attachments to the alveolar bone, and the alveolar bone supporting the tooth. Types of periodontal surgery exposing bone are mucogingival surgery, vestibular surgery, frenulotomy, frenulectomy, osteoplasty, ostectomy, and reattachment procedures.

Mucogingival surgery, vestibular surgery, frenulectomy, and frenulotomy are performed either separately or in combination primarily to correct mucosal aberrations and could be considered as soft tissue procedures. However, alveolar bone, because of its nearness to the oral mucosa, must be considered at the time of surgery and during postoperative healing. Osteoplasty, ostectomy, and frequently reattachment procedures have for their immediate objective some alteration of the alveolar bone and can be classified as osseous surgery. Soft tissue procedures and osseous surgery often require the exposure of bone. It is not the purpose of this paper to give a complete discussion on the techniques of various types of periodontal surgery; the techniques will be referred to only as they are related to exposure of bone.

Mucogingival and Vestibular Surgery

Postoperative objectives in periodontal therapy include an adequate zone of attached gingiva and an acceptable vestibular fornix depth. The vestibular fornix, consisting of alveolar mucosa, is located apically to

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the gingiva and begins at the mucogingival junction. Gingiva, because of its collagenous structure and its firm attachment to the tooth and alveolar bone, is capable of withstanding the functional stresses of mastication and home oral physiotherapy. Alveolar mucosa, because of its elastic structure, mobility, and lack of firm attachment, is not able to withstand similar stresses; thus, it is not desirable to have the alveolar mucosa attached to the tooth, thereby replacing the functional gingival attachment. The marginal gingiva around the tooth must be free of muscle and frenum forces during movement of the cheeks and lips. Therapists are interested in establishing, increasing, and maintaining an adequate zone of gingiva and an adequate vestibular depth.

Osseous Surgery

Osteotomy or osteoplastic procedures are used to correct bony defects resulting from periodontal disease. After periodontal disease, the elimination of a broad alveolar crest, proper contouring of buccal or lingual bone crest, enlargement of involved furcations, correction of infrabony defects, eliminating interproximal bone craters and reducing exostoses are frequently necessary for the initiation and maintenance of periodontal health.

The major types of periodontal surgery involved in exposing bone are initiated by the reflection of a mucoperiosteal buccal, labial, or lingual gingival flap. This is especially true in mucogingival and osseous surgery but is not necessarily true in vestibular surgery. It is of great significance whether the bone remains exposed and unprotected as the result of eliminating the flap by excision, or if the exposed bone is given a protective cover by retaining and then replacing the gingival flap after the surgery is completed. The retained flap could either completely or partially cover the exposed bone; thus, the bone is exposed for a short period of time (that is, temporarily) only during the surgical procedure. If the flap is excised the bone remains exposed after surgery for a longer period of time until it is covered by healing tissue. This bone could be considered as being permanently exposed. There are two main categories into which bone procedures are divided, permanent and temporary, based on whether or not the bone remains exposed at the end of the operation.

SIGNIFICANCE OF HISTOLOGIC CONSIDERATIONS IN BONE-EXPOSING OPERATIONS

Of great importance are two tissues that determine the correct diagnosis, prognosis, and the treatment plan. These tissues are the gingiva and its attachment to the tooth (dentogingival junction complex), and the alveolar bone, especially a 5 to 10 mm. strip of alveolar crest bone.

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Figure 1. Normal buccal view of the mandibular region. A, Radicular area; B, interdental area; C, bifurcation or furcation area; D, level of mucogingival junction area. Note the compact bone and bony crest, spongy bone is present in the interdentinal plate of compact bone is present in all radicular area would possibly exhibit ma

Figure 2. Distal view of buccal through lines A, B and C of Figure 1. A, Bony crest, bony and spongy bone is present in the interdental plate of compact bone is present in all radicular areas would possibly exhibit ma

Surgical exposure of bone could occur over the root of the tooth, the interradicular areas, the roots of adjacent teeth, and the same tooth (Figs. 1 and 2). A structure of these areas is necessary exposure techniques. The buccal or labial areas is very often a narrow plate narrow spaces (Fig. 2A), however this area frequently contains marrow in the apical portion of the vestibular area (Fig. 2B). In contrast the labial areas is very often a narrow plate narrow spaces (Fig. 2C), consisting of matrix material including these areas in the mandible.

The alveolar bone is basically study of bone after exposure of bone in animals and, to a limited extent, material for histologic or histomorphometric in understanding generalized surgery and its relationship to limit
Figure 1. Normal buccal view of the mandibular region. A, Radicular area; B, interdental area; C, bifurcation or furcation area; a, level of marginal gingiva; b, level of alveolar crest.

Figure 2. Distal view of bisectional sections of the mandibular region through lines A, B and C of Figure 1. A, Radicular area; B, interdental area; C, furcation area. Note the compact bone and lack of spongy bone over the tooth root, but spongy bone is present in the interdental and furcation areas. A dense outer cortical plate of compact bone is present in all areas. A broader alveolar bone crest in the radiolar area would possibly exhibit marrow spaces (not shown in this illustration.)

Surgical exposure of bone could occur in three areas: the radicular area over the root of the tooth, the interdental (interproximal) area between the roots of adjacent teeth, and the furcation area between the roots of the same tooth (Figs. 1 and 2). A detailed description of the histologic structure of these areas is necessary for the understanding of bone exposure techniques. The buccal or vestibular alveolar bone in the radiolar areas is very often a narrow plate of compact bone with few, if any, marrow spaces (Fig. 2A); however, a broad vestibular alveolar bone in this area frequently contains marrow spaces. Marrow spaces are evident in the apical portion of the vestibular alveolar bone in the radiolar area (Fig. 2A). In contrast, the interdental and furcation areas consist of a compact vestibular plate with definite underlying spongy bone (Fig. 2B, C), consisting of many marrow spaces. A representative region including these areas is the mandibular molar region.

The alveolar bone is clinically unobservable during healing, so the study of bone after exposure necessitates experimental investigation in animals and, to a limited extent, in humans. The sectioning of experimental material for histologic investigation and evaluation is of primary importance in understanding the subject of bone exposure in periodontal surgery and its relationship to clinical application in a periodontal prac-
PERMANENT BONE EXPOSURE

Immediately after resection of a buccal gingival flap including periodontium, a superficial layer of the exposed cortical plate of the alveolar bone becomes necrotic. Underlying the superficial necrotic bone is viable bone. Fibrin blood clots and underlying inflammatory processes are present at all cut wound edges and at the severed cervical portion of the periodontal ligament. The first phase of repair, the osteoclastic phase (2 to 10 days), results in early resorption of the necrotic bone. This can only be achieved by undermining resorption by the osteoclasts originating in evident marrow spaces and haversian canals beneath the exposed bone (Figs. 3B, 4B, 5B). Over the root area, resorption also occurs on the periodontal surface of the exposed alveolar bone.

Periodontal resorption causes a widening of the periodontal ligament space (Fig. 3B). No resorption occurs on the buccal (vestibular) surface of the exposed bone; however, at 6 days resorption is evident peripherally to the wound edges. The result of all resorption processes is the removal of the exposed necrotic bone and the viable vestibular plate beneath the necrotic bone.
in the mouth result from an exacting process and the alveolar bone, the alveolar process of the dentition, and to some extent the socket of bone supported by the alveolar process of the maxilla. What is the purpose of bone exposure? Is it to enhance the repair process? What are the types of bone exposure? Exposure can be surgical or orthodontic.

Then, inter-dentisperistatic disc...

Figure 3. Permanent bone exposure by excision of the buccal flap in the mandibular area. A. Normal. B. 2 to 4 days; C. 4 to 10 days; D. 180 days. a. 5 mm. of bone exposure and complete loss of alveolar crest. b. 2.5 mm. loss of bone at the end of the repair process. d. New connective tissue attachment. e. Epithelial attachment to cementoenamel junction. g. Young connective tissue. A. Incisions; epithelium and connective tissue removed, baring the bone; arrows indicate direction of resorption. f. Epithelium at lower level.

Figure 4. Permanent bone exposure in the inter-dentisperistatic area by excision of the buccal flap. A. Normal. B. 2 to 4 days; C. 10 days; D. Complete regeneration of oral mucosa and alveolar bone after 180 days.

Figure 5. Permanent bone exposure in the buccal area by excision of the buccal flap. A. Normal; B. 2 to 4 days; C. 6 to 10 days; D. Complete regeneration of oral mucosa, alveolar bone, and periodontal ligament.
newly formed bone is being apposed on the same surface of the alveolar process where resorption had occurred previously at the 4 to 8 day postoperative period. Bone formation continues for 21 days after surgery.

The formation of collagen in the granulation tissue present over the bone begins in the 6 day postoperative period. Later, fine connective tissue fibers are present in this area and within 21 days the fibers are replaced by small connective tissue fiber bundles. This zone of small fiber bundles is between the alveolar bone that was temporarily exposed and the replaced gingival flap. As described previously, a fibrin clot first occupied this zone; later, granulation tissue replaced the fibrin clot. The small connective tissue fiber bundles are embedded into the newly forming periosteal surface bone and form a union between the bone and the large connective tissue fibers of the replaced gingival flap. In this zone, the three month postoperative specimens display dense connective tissue fiber bundles that are normal for gingiva. Clinically and histologically the gingival flap appears normal. The positions of the marginal gingiva, the gingival crevice and the epithelial attachment, as related to the tooth, are similar to their preoperative positions (Fig. 8A-D). The alveolar bone crest is insignificantly lowered and narrowed (Fig. 6D). The healing following this temporary bone exposure procedure is by first intention, whereas the permanent bone exposure procedure that lacks the replacement of a gingival tissue flap heals by second intention.

**INTERPRETATIONS FOR CLINICAL APPLICATION**

Histologic evidence in reference to bone exposure during periodontal surgery presents interpretations of value to the clinician in his selection of surgical techniques for specific periodontal problems. Indications and contraindications for the correction of periodontal problems and the accomplishing of postoperative objectives can be related to techniques utilized during therapy.

**Bone Exposure and Mucogingival Surgery**

A limited increase of new gingiva can be created in mucogingival procedures by leaving the alveolar bone demineralized of soft tissue after surgery and also by immobilizing any mobile soft tissue wounds edges by suturing. Periodontal dressings and splints are aids in immobilizing wound edges. The amount of increase is limited by fibrous or muscle reattachment in the mucobuccal fold area. The position of the regenerating marginal gingiva attached to the tooth is frequently at a slightly lower level, although the fibrous attachment to the tooth above the alveolar crest is increased. The increased length of fibrous attachment to the tooth above the alveolar crest is the result of a lowered alveolar crest. The increase in the zone of the gingiva is at the expense of a

**EXPOSURE OF BONE IN PERIODONTITIS**

...diminished alveolar mucosa api-decrease in depth of the vestibulum propria) of the gingiva arises from a loss of its origin the loose connective tissue systems, the periodontal ligament spaces (Figs. 4C, 5C) and potential sources of granulation tissue new gingival tissue aids in giving to the connective tissue and epithelium.

Although this is a relatively the zone of the gingiva, a disparity to 4 mm. of crestal alveolar bone of healing (Fig. 3D). The loss of determined by the presence of a absence of spongy bone with its presence, it is necessary to note again narrow spaces. Little or no crestal (Fig. 4D) and furcation areas (posed in this procedure. The buccal consists of spongy bone underlýing post bone. A great quantity of bone exists necessary for complete regrowth and the gingiva overlying the buccal bone contain a great quantity of connective tissue proliferates and it finally differentiates into the bone- propria of the gingiva.

**Permanent Exposure and Osseous**

The results of permanent bone paragraph, indicate that a simple bone, with its crest at the same level at the interdental and furcation a crest level over the root after heal procedures correcting bony defects, labial, or lingual alveolar crest (F a bony architecture considered b connotate the surgical contour of the crest of the bone over the t than the bone crest in the intened level bone crest in all areas is adeq

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diminished alveolar mucosa apical to the gingiva as well as a possible
decrease in depth of the vestibular forun. The connective tissue (lamina
propria) of the gingiva arises from proliferating granulation tissue which
has as its origin the loose connective tissue of the marrow spaces, haver-
sian systems, the periodontal ligament, and the wound edges. The mar-
row spaces (Figs. 4C, SC) and periodontal ligament (Fig. 3C) are excel-
ent sources of granulation tissue. Later, functional stimulation of the
new gingival tissue aids in giving structural arrangement and maturation
to the connective tissue and epithelium characteristic of normal gingiva.

Although this is a relatively predictable procedure for increasing the
zone of the gingiva, a disadvantage in this technique is the loss of 2
to 4 mm. of crestal alveolar bone over the tooth root at the termination
of healing (Fig. 3D). The loss of bone over the tooth root seems to be
determined by the presence of a compact cortical plate of bone and the
absence of spongy bone with its marrow spaces in the crestal area; how-
ever, it is necessary to note again that a broad alveolar crest may contain
marrow spaces. Little or no crestal bone loss occurs in the interdental
(Fig. 4D) and furcation areas (Fig. 5D), the other anatomic areas ex-
posed in this procedure. The bone of interdental and furcation areas
consists of spongy bone underlying an outer cortical plate of dense compa-
tact bone. A great quantity of spongy bone with its marrow spaces
seems necessary for complete regeneration of the alveolar crestal bone
and the gingiva overlying the bone. The many marrow spaces of spongy
bone contain a great quantity of loose connective tissue. This loose con-
nective tissue proliferates and is the source of the granulation tissue that
finally differentiates into the bone of the alveolar crest and the lamina
propria of the gingiva.

Permanent Exposure and Osseous Surgery

The results of permanent bone exposure, as presented in the above
paragraph, indicate that a simple exposure of a narrow strip of alveolar
bone, with its crest at the same level over the root of the tooth as it is
at the interdental and furcation areas, will result in a more apical bone
crest level over the root after healing. This is applicable in those osseous
procedures correcting bony deformities by a leveling of the buccal,
labial, or lingual alveolar crest (Fig. 7). After healing, this would create
a bony architecture considered by some to be physiologic. This would
minimize the surgical contouring of a thin buccal plate of bone, so
the crest of the bone over the tooth root is at a more apical position
than the bone crest in the interdental or furcation areas (Fig. 7B). A
level bone crest in all areas is adequate.

A broad plate of bone lacking fenestrations and dehiscences is a
prerequisite for permanent bone exposure and compensates for some
bone loss following this type of bone exposure. An optimal condition
would be a broad alveolar crest containing marrow spaces. Seemingly,
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The gingiva is split with a sharp knife, the outer portion is excised, and the inner portion is retained and remains attached, covering the alveolar process. Thus, connective tissue instead of bone is exposed in the oral cavity. A disadvantage of this altered technique is the presence of an intermediate type of gingiva lacking some characteristics of mature normal gingiva. This latter technique is less traumatic in comparison to the bone exposure procedure. Surgery to the bone, in itself, will require the penetration and removal of the retained connective tissue cover at the site of the surgery and will result in the exposure of the cut bone surface. Other disadvantages of the retained tissue bone cover technique are the lack of visibility and surgical access to the bone. To eliminate these disadvantages, the surgically exposed bone operation is the method of choice over the retained connective tissue procedure.

Temporary Exposure and Osseous Surgery

To minimize the disadvantages of permanent bone exposure, especially the loss of the alveolar bone crest and the reduction of pain, specific procedures have been stressed to the dental profession. These procedures emphasize the replacement of the gingival flap (Fig. 8A,B) over the surgically exposed bone instead of excising it. These surgical techniques of temporarily exposing bone by the retained mucoperiosteal gingival flap procedure are frequently necessary to provide access and visibility for osseous surgery to correct bone defects. The flap is either replaced to completely cover the exposed bone (Fig. 8C) or repositioned to partially cover the bone, leaving an area of crestal bone exposed (Fig. 8D). In repositioning the flap, 1 to 3 mm of alveolar crest is left exposed before the periodontal dressing is placed.

From what has been related before, it will be understood that the interdental and furcation bone completely regenerates in the most traumatic

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**Figure 8.** Temporary bone exposure procedure as presented in “interpretation” section. A, Distal view of mandibular molar, p, pocket is present and bone resorbed to level n; arrow indicates direction of incision to remove gingival epithelium. B, Flap is reflected and if the alveolar crest is broad it could be reduced as indicated by small arrow. C, Flap is either replaced, completely covering the bone (flap is present around the tooth) or D, repositioned flap leaves 1 to 3 mm of crestal bone exposed.

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The Current Status of Gingivectomy

ARThUR Gold, D.

It is the purpose of this presentation to review the role of the gingivectomy in the treatment of gingival disease and to examine the effectiveness of the procedure in various clinical situations. The gingivectomy is a surgical procedure that involves the removal of the gingiva, or gum tissue, from the teeth. It is performed to remove inflamed tissue and to improve the appearance of the gumline. The gingivectomy is often used in conjunction with other periodontal treatments to achieve optimal results.

The gingivectomy is an effective procedure for the treatment of gingival disease, but it is not a cure-all. It is important for patients to understand the limitations of the procedure and to work with their dentist to develop a comprehensive treatment plan.

THE NATURE OF PERIODONTAL DISEASE

Chronic destructive periodontal disease, which causes inflammation of the gingiva and bone loss, is the most common form of periodontal disease. It is caused by plaque and calculus accumulation on the teeth, which leads to inflammation of the gingiva and eventual destruction of the supporting bone.

It is important to understand that periodontal disease is a chronic, progressive condition that can affect people of all ages. It is not a temporary condition that goes away on its own, and it is important to take steps to prevent and treat it.

This concept of co-destructive periodontal disease suggests that the treatment of periodontal disease should be approached as a comprehensive, multidisciplinary effort that includes dental treatments, systemic medications, and lifestyle modifications. Such an approach can help to improve outcomes and quality of life for patients with periodontal disease.

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