Refinement of Gingival Margins: Biological Depth vs. Zone, and a Diode Laser

Abstract

Gingivectomy refines dental esthetics by correcting gingival margins and improving dental crown forms to enhance outcomes for orthodontic and interdisciplinary treatment. The predictability of a gingival revision depends on preoperative planning, which is based on a thorough understanding of the form and function of a healthy periodontium. The epithelial attachment (EA) is composed of three periodontal tissues: sulcus depth (SD) of marginal gingiva, connective tissue attachment (CTA), and junctional epithelium (JE). The combination of two anatomical tissues (CTA and JE) is defined as the biologic or biological width. It is the physical barrier that protects sterile internal tissues from the microbes of the oral cavity. The tissues of the biological width are bordered and protected by an immunologic buffer zone (SD). In effect, all three tissues (SD, CTA, JE) function together as a biological zone, which is an essential physiologic barrier between the oral cavity and alveolar bone. The biological zone must be preserved during a gingivectomy procedure, to avoid the longterm chronic inflammation due to a biological width violation. The traditional method for removing excessive gingival tissue is excision with a scalpel, which has the disadvantages of a long and relatively complex operation, followed by an extended healing interval. Oblation of excessive gingival tissue with a diode laser reduces the duration and complexity of the surgical procedure, plus it shortens the recuperative (healing) period. Additional advantages of laser surgery are minimal probability of infection, and little or no pain. Diode lasers are a superior gingivectomy option for both patients and clinicians, but the biological zone must be respected. (Int J Orthod Implantol 2017;48:104-108)

Key words:

Gingivectomy, biologic or biological width, connective tissue attachment, junctional epithelium, sulcus depth, biologic or biological zone, diode laser.

Introduction

Kings and emperors constructed castles with moats for protection from invaders. This is analogous to the oral physiologic triad that protects the monarch of the periodontium: alveolar bone. A castle wall and moat (*Fig. 1*) are similar barriers compared to the connective tissue attachment (*CTA*) and the junctional epithelium (*JE*) concept of Cohen.[1] In effect, alveolar bone is protected from the invasion of bacteria, foreign materials, infection, and disease by an anatomic barrier.

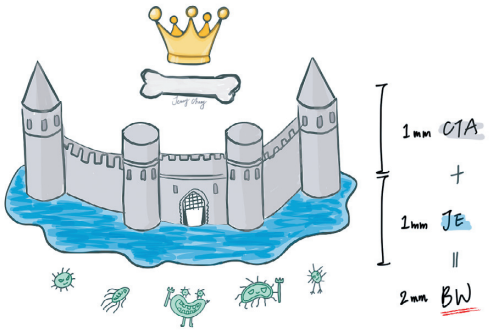

Fig. 1:
The king of the periodontal realm is bone as denoted by the crown. A castle wall is analogous to the 1mm connective tissue attachment (CTA), and the moat represents the 1mm junctional epithelium (JE). The CTA (1mm) and JE (1mm) combine to provide a biological width (2mm) that serves as a barrier to microbe invasion from the biofilm that coats teeth (below).

Dds. Jennifer Chang,
Clerk, Beethoven Orthodontic Center (Left)
Dds. Laurel Shern,
Clerk, Beethoven Orthodontic Center (Center left)
Dds. Kristine Chang,
Clerk, Beethoven Orthodontic Center (Center right)
Dr. W. Eugene Roberts,
Editor-in-chief, International Journal of Orthodontics & Implantology (Right)

Biological Width or Biological Zone?

What is the distinction between the anatomic term biological width and the more physiologic concept biological zone? The EA or dentogingival junction is the linear dimension of the soft tissue that links the attached gingiva to the cervical portion of a tooth root, coronal to the crest of the alveolar bone. Gargiulo et al.[2] described a healthy human dentogingival junction as a biological zone of about 3mm of soft tissue extending from the gingival margin to the crest of the alveolar bone (*Fig. 2A*). It was subdivided into ~1mm of connective tissue attachment (*CTA*), ~1mm of junctional epithelium (*JE*), and ~1mm of sulcus depth (*SD*). According to Ingber, Rose and Coslet,[1] Cohen is credited with introducing the term biological width to describe the combined width of the CTA and JE. Kois[3] expanded the term to biological zone to embrace the entire concept of Gargiulo et al.[2] who included sulcular depth as an integral component of the attachment apparatus (*Fig. 2B*). From a restorative perspective, the definition of Kois[3] is more practical because the 3mm biological zone is readily identified clinically from the marginal crest of the gingiva.

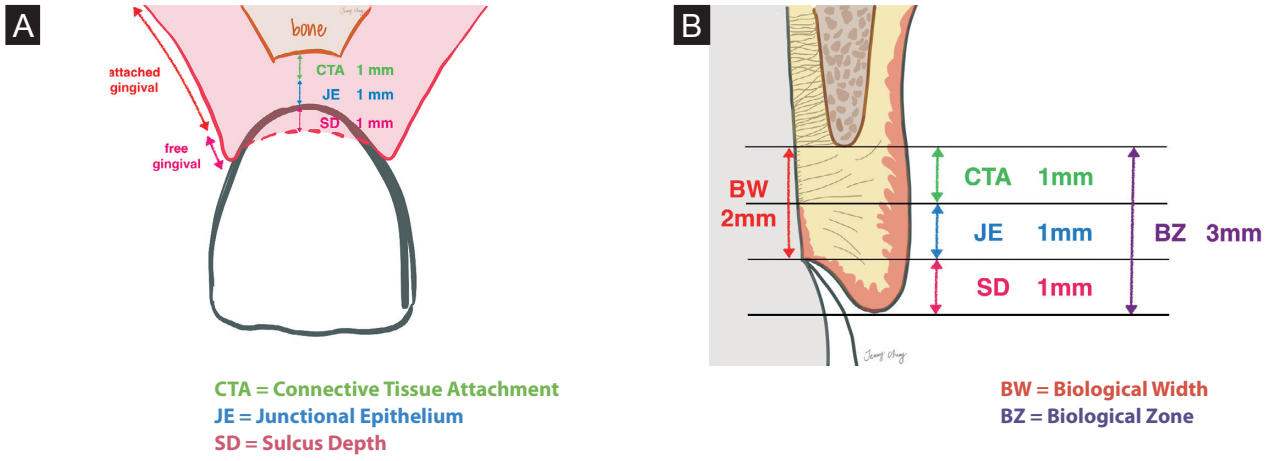

Fig. 2:

A. A healthy periodontium has a ~3mm biological zone of epithelial attachment composed of three tissue layers (CTA, JE and SD) which protects the bone form the oral environment.

B. The combined height of CTA and JE is defined as the biological width (BW). The combined height of CTA, JE and SD is defined as the biological zone (BZ).

Monitoring gingival health

The gingival sulcus is the clinical window to periodontal health[4] so it is a critical component of the biological zone. Although gingival health is easily monitored by sulcus depth and bleeding on probing, these routine methods do not detect all periodontal disease,[5] but they are good clinical measures for planning a gingivectomy for esthetic purposes. A healthy periodontium is a prerequisite for all gingival revisions related to the refinement of esthetics. A healthy gingival sulcus has an important immunologic role in protecting the underlying attachment tissues, as part of the overall protection of the gastrointestinal tract.[6] In addition, the increased flow of crevicular fluid in response to inflammation helps to further protect the epithelial attachment.[7] Returning to the analogy of the castle (*Fig. 1*), crevicular fluid from an inflamed sulcus is much like an overflowing moat that repels invaders. Thus maintaining a healthy periodontium requires that the gingival margin be at least 3mm occlusal to the alveolar crest of bone.

How is this applied to patients?

Marginal gingivitis must be controlled with good oral hygiene prior to planning gingival modification to enhance dental esthetics. The clinician carefully evaluates the nature of the EA when considering a gingivectomy. Simply measuring the depth of the gingival sulcus is inadequate. A good understanding of the fundamentals defining the biological width and zone are essential for determining how much soft tissue can be safely removed from the gingival margin. The critical step in planning a gingivectomy is bone sounding under local anesthetic with a periodontal probe to determine the height of the alveolar crest relative to the gingival margin. If the dimension exceeds 3mm, the surplus gingiva is expendable. For example, a patient with a sounding depth of 4mm (*Fig. 3a*) is a candidate for a 1mm gingivectomy (*Fig. 3b*). Removing too much gingival tissue creates a biological zone violation which is often manifest as chronic gingival inflammation.[4] Maintaining ~1mm of sulcular depth is important for the physiology of the biological zone to preserve the integrity of the anatomic barrier. Violating the biological width usually must be corrected with a surgical reduction of the alveolar crest.[4]

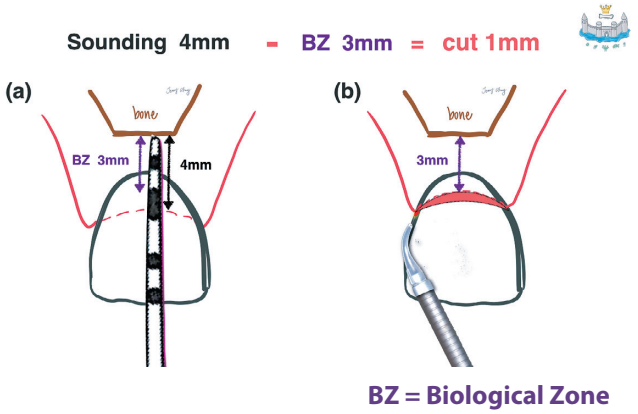

Fig. 3:
(a) Bone sounding of 4mm is performed with a periodontal probe. Subtract the BZ of 3mm and then 1mm of marginal gingiva can be removed.
(b) The pink shaded portion is the 1mm of soft tissue removed with the laser.

Fig. 4:
A. A frontal view of the anterior maxillary segment shows irregular gingival margins, a hypertrophic maxillary frenum, and two bleeding sites where miniscrews were removed from between the roots of the central and lateral incisors.
B. Following the diode laser gingivectomy the gingival margins are near ideal, and a frenectomy has been performed.
C. Following soft tissue healing, the gingiva margins are maintained and no scarring is evident.

Diode laser

For a patient with a bone sounding depth of 5mm, 3mm was subtracted to preserve the biological zone, so a maximum of 2mm of gingival height could be selectively removed (*Fig. 4A*). An Epic X® (*Biolase, Irvine, CA*) diode laser (*Fig. 5*) was used to refine the gingival margins and simultaneously perform a frenectomy (*Fig. 4B*). The soft tissue healed uneventfully resulting in enhanced dental esthetics (*Fig. 4C*). The laser emission wavelength is 812 to 980 nm which is maximally absorbed by the pigmentation (*melanin*) of the soft tissue, thereby producing excellent hemostasis. The Epic X® diode laser is designed (*power and wavelength emission*) to only cut soft tissue, with little appreciable effect on hard tissue (*bone or enamel*). It also provides tactile feedback in the contact mode to facilitate precise contouring of gingiva during the surgical procedure.[8] In addition, the intense coherent light seals off blood vessels and lymphatics at the surgical site resulting in a dry, more visible field. Postoperatively the wound is sealed with a biological dressing, to help prevent infection, control damage to adjacent tissue, minimize pain, reduce swelling, and eliminate scars. Overall, the diode laser has a shorter operative time and faster postoperative recuperation compared to traditional gingivectomy using a scalpel.[8] In addition to soft tissue oblation, the Epic X®diode laser is capable of tooth whitening and TMJ pain relief. Furthermore, it delivers faster pulses, as short as one

Fig. 5:
Epic X® diode laser advantages are listed as: versatile, powerful, efficient and portable. See text for details.

millionth of a second, to decrease the heat delivered to the tissue which increases patient comfort. The unit is small, portable, and uses disposable tips, which cuts down on setup and procedure time.

Conclusion

Gingival shape, contour and crown length are easily adjusted with a diode laser, but all gingivectomy procedures must respect the ~3mm biological zone.

Bone sounding under local anesthesia is the most reliable method for defining the height of the alveolar crest. Ideal tooth proportionality and harmonious gingival contours contribute to more esthetic outcomes.

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