Radiosurgery—The Second Handpiece for Tissue Preparation in Contemporary Restorative Dentistry

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In restorative dentistry and, in particular, contemporary esthetic restorative dentistry, tooth preparation alone will not satisfy the requirements for comprehensive treatment. Soft tissue control and modification are essential to ensure an optimal restorative and esthetic result. Tissue control and modification can be accomplished by using chemicals and retraction cord, high-speed diamonds, scalpels, and lasers. Whereas all these methodologies have their applications, advantages, and disadvantages, radiosurgery offers many unique advantages and must not be overlooked as a treatment alternative. A high-speed handpiece and a radiosurgery handpiece should both be available during the preparatory phase of treatment so both hard and soft tissues will be prepared optimally and conveniently.

What Is Radiosurgery?
Radiosurgery consists of a high frequency radio wave between 3.8 MHz and 4 MHz, which is above AM (amplitude modulation) and below FM (frequency modulation). This high frequency radio signal produces a pressureless, microsmoothe incision with hemostasis and a minimum amount of tissue alteration if used properly. The radiosurgery instrument produces the radio wave, and it is transmitted to an active and passive destination or electrode. The active electrode is a small microfiber RFx or tip with multiple configurations that are used to modify soft tissues. The passive electrode ends in a passive antenna device that is placed in close proximity to the surgical site with nonskin contact. The radio wave can now be transmitted through the soft tissues between the active and passive electrodes. The passage of these high frequency radio waves causes microsmooth cutting of soft tissues. This waveform produces the least amount of heat, lateral tissue destruction, and shrinkage. Incisions made with this waveform most closely resemble those made with a scalpel when the least amount of hemostasis is produced. It is also the only waveform that can be used in close proximity to bone with the minimal amount of heat produced. This waveform is recommended for procedures in which trauma must be kept to a minimum.

Fully Rectified Filtered Waveform
The fully rectified waveform is a full wave current that has been modified by electronic filtration to produce simultaneous cutting and hemostasis. This waveform creates tissue shrinkage and increased lateral heat and should not be used close to bone. This waveform is recommended for use when simultaneous cutting and hemostasis is desired and adequate soft tissue bulk exists.

Partially Rectified Waveform
The partially rectified waveform is an intermittent flow of high frequency current that is excellent for producing hemostasis in soft tissues. This waveform produces an even greater amount of tissue shrinkage and lateral heat and must not be used near bone.

Fuluration Waveform
The fuluration waveform is a half wave current that has a dehydrating effect on tissues. This waveform produces the greatest amount of lateral heat and is used for coagulation and

Waveform Modification and Application
The waveform of a radio signal is variable. Various waveforms have different applications and indications in radiosurgery (Figure 1).

Figure 1—Comparative differences of the four waveforms in radiosurgery.
destruction of cyst remnants only. It can be used near bone because the electrode should not touch the tissue. A pencil- or spear-shaped active electrode is placed about 0.5 mm above the tissue. When the radiosurgery unit is activated, a spark jumps from the electrode to the tissue causing coagulation to the point of carbonization.

Control of Lateral Heat

Lateral heat is produced in the tissue and minimized to limit lateral tissue destruction. The variables that must be controlled are time, intensity, frequency, waveform, and electrode size.

Time

Time of application will affect the amount of lateral heat produced. Consequently if the active electrode is moved slowly through soft tissue, a greater amount of lateral heat and width of tissue destruction will occur. The rate of about 7 mm/sec is the optimal rate for minimizing lateral heat. Tissue contact time should be limited to minimize lateral tissue destruction. It has been shown that about 10 to 15 seconds should elapse before returning to the surgical sight for additional cutting. Using a water spray can reduce this cooling period.

Intensity

Power intensity of the radiosurgery unit must be adjusted properly for optimal cutting and minimal tissue destruction. Different tissue types will require different power intensity settings. If the power intensity is set too high, sparking and charring will occur. If the power intensity is set too low, tissue drag and sticking will occur. A clean tissue incision will result if the power intensity is set properly. Note that if thick fibrotic tissue exists, the intensity needs to be increased. If hyperemic tissue exists with excessive bleeding, the power intensity should be reduced.

Frequency

A radiosurgery unit that operates at a lower frequency will result in a less efficient incision, increased lateral heat, and delayed healing. Less tissue destruction is produced at a frequency near 4 MHz when compared to a frequency near 1.7 MHz.

Waveform

Four waveforms are available in dental radiosurgery and have already been discussed. It has been shown that the fully rectified and filtered waveform produces the least amount of tissue destruction.

Electrode Size

Active electrodes come in many sizes and shapes to accommodate a wide range of applications. A greater amount of power intensity must be used for larger electrodes, which results in a greater amount of heat and potential tissue destruction. As the active electrode size increases, greater care must be taken to control the variables that can lead to excessive and unnecessary tooth destruction.

Clinical Applications of Radiosurgery

There are many radiosurgical, active electrodes or surgical tips that are available in different shapes and sizes for a broad range of applications and personal preference. The four main
surgical tips used by the author are shown in Figure 2. The vari-tip electrode is used most commonly and is used for cutting and shaping where access permits. The pencil electrode is useful for enlarging the gingival sulcus (troughing) and coagulation during impression procedures. The ball electrode is useful for hemorrhage control. The loop electrode is useful for removing excess interproximal tissues and troughing in the posterior part of the mouth, where access is poor for the vari-tip and tissue thickness is greater. It is also useful for beveling or thinning tissue (gingivoplasty). A larger loop (not shown in Figure 2) is useful for edentulous ridge contouring.

Esthetic Tissue Contouring
The demand for esthetic results is high. It is no longer enough to only provide restorations that look natural in color; they must be symmetrical in size and form, and tissue modification is often required to achieve this goal. Where the biologic width is adequate for a gingivectomy and/or gingivoplasty, radio-
Tissue Removal for Restorative Access

Tissue contouring is often required during a restorative procedure. The removal of tissue around cervical caries to gain restorative access is a common and simple procedure. The removal of redundant tissue that has grown over a fractured tooth is necessary to gain better access for restorative procedures (Figures 7 and 8).

Redundant tissue removal and esthetic contouring in conjunction with anterior restorative procedures is a more complicated and demanding procedure. The clinical sequencing must be varied to optimize postoperative stability. Tissue removal that violates an individual’s biologic width will not have long-term stability (Figures 9 through 11). Lack of tissue stability may require more invasive flap surgery and osseous contouring.

Tissue contour and stability must be verified before finalizing restorations (Figures 12 through 16). In more complex cases, provisional restorations are placed after radiosurgery, and tissue stability and health must be evaluated before placing final restorations (Figure 17 through 21).

Ridge Reduction

Redundant tissue in ponic areas is easily removed and contoured using a larger loop electrode. Tissue thickness after contouring should be a minimum of 2 mm to ensure adequate biologic width and optimal tissue healing (Figures 22 through 24).

Impression Techniques

As a dentist and a laboratory owner, the author knows the importance of making complete and accurate impressions. The key to making a good impression is the first time; tissue and fluid control. Radiosurgery is invaluable in the removal of excess tissue. If the tissues are thick enough, it can also be used to create a space or trough adjacent to the prepared tooth (Figures 25 and 26). With proper training and experience, radiosurgery can reduce the need to use string and/or chemicals. The small pencil-shaped troughing tip shown in Figure 2 is an excellent choice for areas in the mouth where tissue is thinner and stability is necessary.

CONCLUSION

If a radiosurgery handpiece is available during restorative procedures and the operating dentist is adequately trained, radiosurgery can be a routine part of restorative treatments. The key is to not store it away in a cupboard where it is inconvenient to use on a moment’s notice. Esthetic and restorative procedures can be substantially improved and made easier through the use of radiosurgery.

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