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IMPLANTS

Implant Surgery and High-Frequency Currents

Operative Indications

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The physical consequences of passing an electrical current by means of a metal insert have made it possible to develop the concept of electrical bistoury. Its characteristics are limited by incision and thermocoagulation but are accompanied by a significant temperature increase, which results in tissue degradation and retractile tissue scarring.

High-frequency, low-temperature radiosurgery offers a different approach to operating and to the clinical consequences resulting from it. The specific current of 4 MHz makes it possible to undertake fine incisions in implant areas and offers maximum operative visibility (Figure 1).

This technique is of interest at each stage of the implant operation: (1) positioning of the implant (embedded or nonembedded implant); (2) bringing the implant into use; and (3) preparation of the preprosthetic gingival tissue.

High-frequency, low-temperature radiosurgery offers a different approach to operating and to the clinical consequences resulting from it.

PHYSICAL CHARACTERISTICS

The frequency emitted by an electrical bistoury varies between 450 kHz and 1 MHz.

The use of the current in the electrode brings about a significant increase in temperature, approaching 800°C, which causes tissue carbonization. The patented 4-MHz radiofrequency results from the rectification and major filtration of the electrical current, creating a very low energy level of between 8 and 25 W by means of a high-frequency current generator. The higher the frequency, the less need there is for a strong current that brings about a calorific effect, which explains the low temperatures observed (Figure 2).[1-4]

The rise in the tissue temperature created by the tip of the electrode remains lower than 100°C. The high-frequency current generates a molecular hyperfrequency in the tissue.

More specifically, it brings about the ionic agitation of the intracellular water molecules,

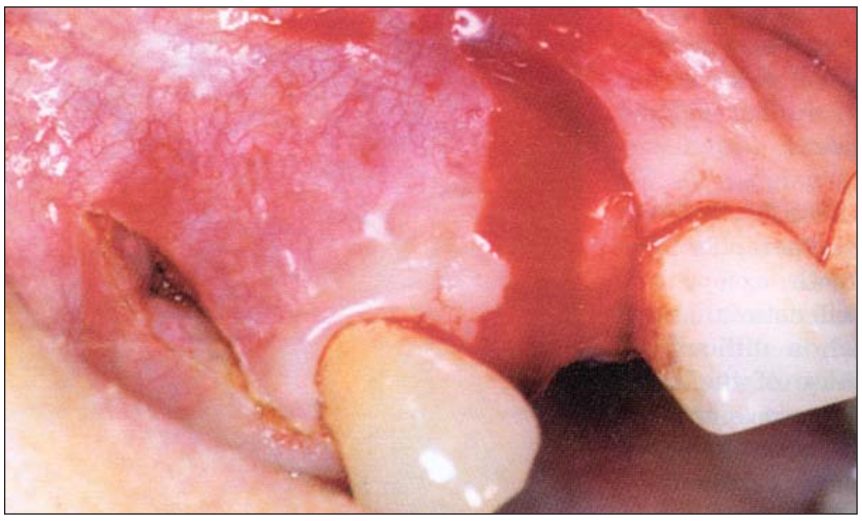

Figure 1. Full-thickness incision using a scalpel on the patient's left side. Full-thickness incision using a microfiber with radiofrequency on the right side. Note the absence of hemorrhagic weeping on the right side.

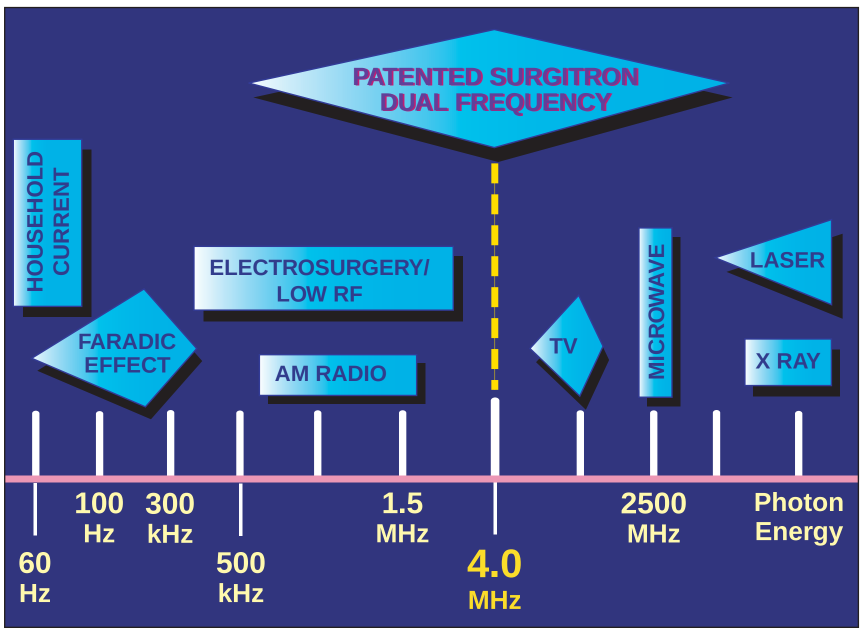

Figure 2. Electrical power levels diagram. (Left to right in the diagram: domestic current, Faraday effect, electrical bistoury, AM radio, radiosurgery-optimal frequency 4 MHz, television, microwave ovens, x-ray, laser.

leading to immediate cell volatilization of the walls of the incision.

We can see peripheral heat release owing to multiple factors in accordance with the following formula: peripheral heat = (power intensity x current sweeping duration x surface) ÷ frequency.

A significant increase in the electrical frequency reduces the quantity of lateral heat.

The filtering and rectification of the electrical current are thus responsible for the various modes of use: (1) totally filtered wave (cut mode)—continuous flow of nonpulsed, high-frequency waves; extremely low level of lateral heat and minimal tissue damage (Figure 3); (2) totally rectified modulated wave (cut/coag mode)—section and coagulation effect (Figure 4); partially rectified modulated wave (coag mode); intermittent flow of high-frequency waves; vascular coagulation and hemostasis (Figure 5).

The equipment used requires a generator emitting a current of 4 MHz (since the cut/coag mode is most frequently used). An example would be the Ellman generator (Figure 6). The electrode operates as the anode, and in single-pole mode, a receptor antenna (the cathode) is required in the form of a plate, which is placed on the patient's back. (It is necessary to ask if the patient has a pacemaker, which could disrupt the electrical functioning of the apparatus.) The application of the electrical current is achieved by means of a foot control (after regulating the intensity using the dial on the generator). A large number of electrodes, which look more like microfibers, are available and are suited to most types of operations (Figure 7).

The clinical advantages of radiofrequency include the guarantee of very precise, nonhemorrhaging incisions. Unlike scalpel incisions, there is no need to apply pressure. On the contrary, the microfiber is drawn like a thread over the tissue surface, gradually opening the tissue walls. The shape of the microfiber eliminates the risks associated with the manipulation of scalpels in relatively inaccessible areas while guaranteeing the sterilization of the operative field (Figures 8 and 9). As a result, after the operation it, is possible to reposition the flaps on either side of the clean incision since they are unlikely to develop postoperative hematomas.[5-7,9]

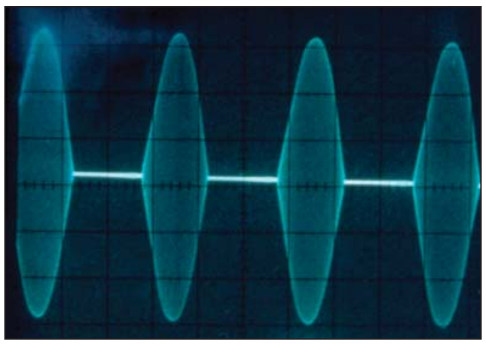

Figure 3. Totally filtered current.

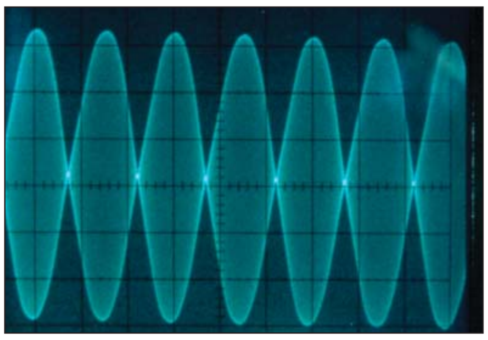

Figure 4. Totally rectified current.

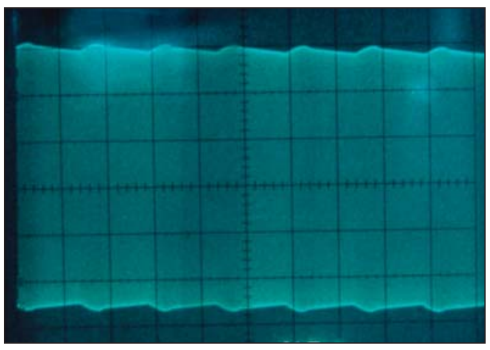

Figure 5. Partially rectified current.

Figure 6. The Ellman generator.

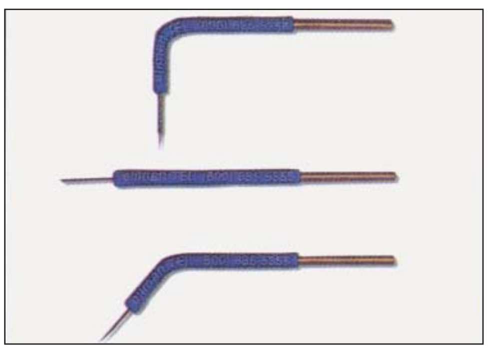

Figure 7. Microfibers adapted to the various operative fields.

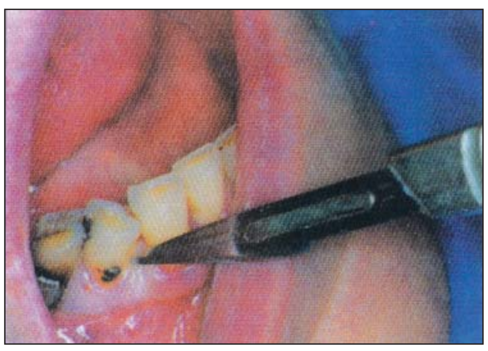

Figure 8. Open blade incision. The risk of lesions in the surrounding tissue during the operation cannot be excluded.

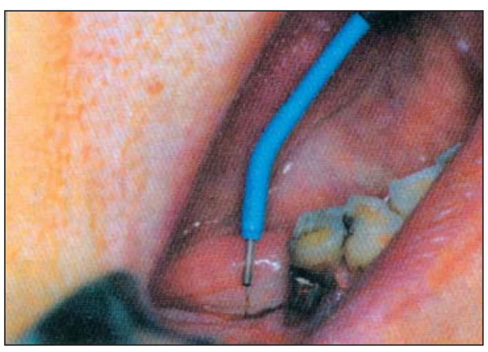

Figure 9. Radiofrequency incision.

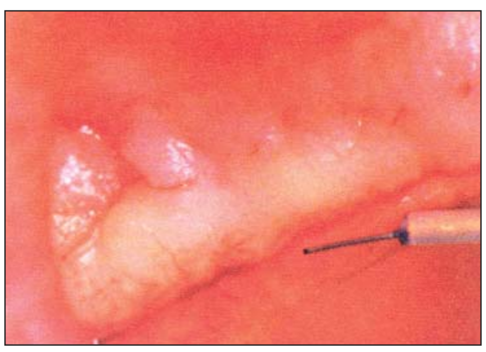

Figure 10. Incision on the crest.

INDICATIONS FOR IMPLANT SURGERY

Radiosurgery is suitable for the various stages in implant surgery.

Positioning Of Implants

Incisions. The incision is achieved by means of microfibers in order to create flaps of full or partial thickness. This can begin either on the gingival crest line or can be offset to ensure a nonhemorrhaging incision line. In contrast to an open blade bistoury, the cutting action does not involve pressure. No tissue retraction is observed during the initial incision, but an opening of the superficial layers occurs. The second sweep completes the incision down to the periostic layer. This technique guarantees progressive cutting, with very little tissue hemorrhaging. The fineness of the cutting line will subsequently make it possible to reposition the sides of the incision easily (Figures 10 and 11).[8]

The volatilization energy is mainly transmitted at the tip of the electrode, which explains the absence of thermal damage on the walls of the incision during successive sweeps of the electrode. The result is thus greatly improved through scarring without hematomas or reactional edemas.

Positioning of embedded implants. The repositioning and suturing of the mucosa surfaces over the top of the implant base cover are achieved with clean surfaces, without any tissue dehiscence or risk of secondary embedding.

Positioning of nonembedded implants. The

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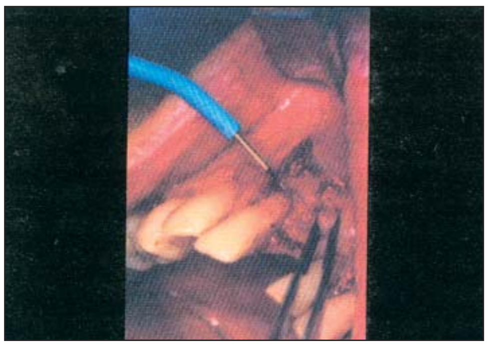

Figure 11. Nonhemorrhaging incision line.

Figure 12. Incision around nonembedded implant.

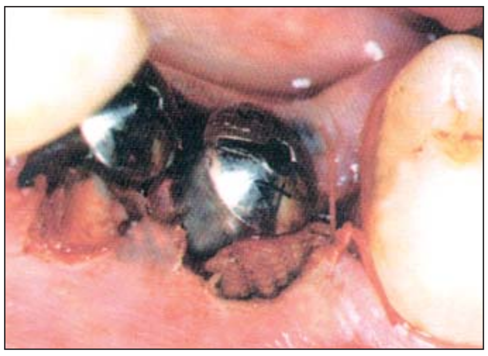

Figure 13. Preparation of the gingiva around the scar tissue pillar.

Figure 14. Gingival scarring after 15 days.

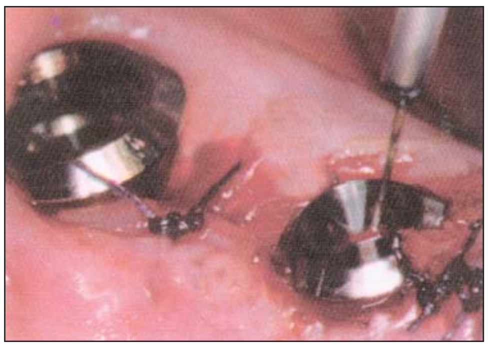

Figure 15. Sculpting of the gingiva around the scar tissue pillar.

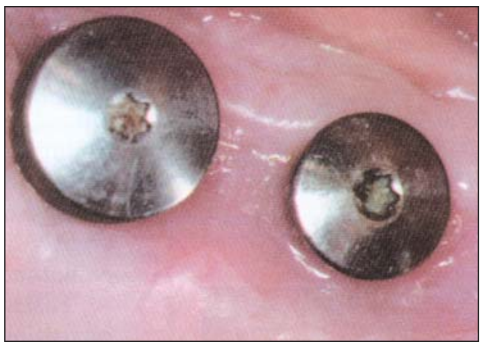

Figure 16. Gingival scarring after 20 days.

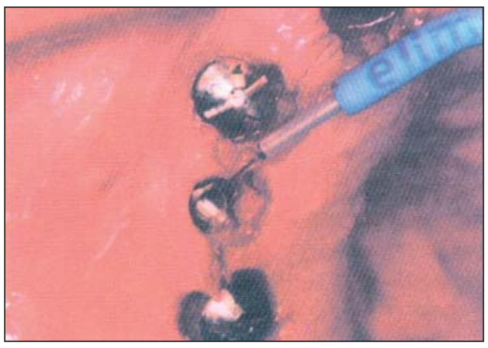

Figure 17. Clearing the area of the implant base cover before positioning the scarring ring.

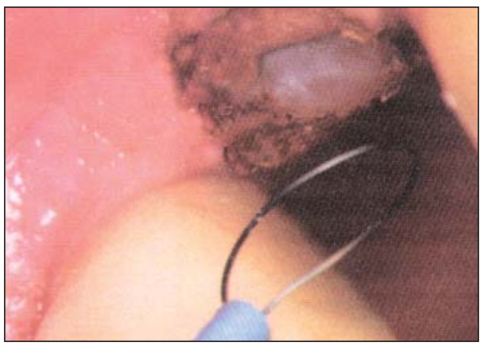

Figure 18. Clearing the area of the implant with other microfiber.

Figure 19. Radiofrequency allows precise incisions.

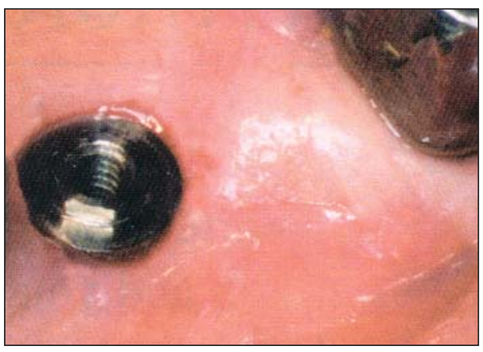

Figure 20. Note the cicatrization around the implant base.

surgeon can arrange the gingival tissue around the edge of the cover screw and the top of the implant from the outset of the operation. Any contact with the electrode at the implant head does not cause electrical arcing that is sometimes encountered with electrical bistoury. The patient suffers no pain around the implants. Thus, it is quite simple to sculpt and arrange the gingiva precisely within 0.5 mm of the implant (Figure 12).[9,10]

The effect of tissue volatilization soon leads to reactional fibrosis of the mucosa, making it possible to achieve gingiva that is not inflamed around the head of the implant after the operation. Having used this current, the postoperative result after 2 weeks is reflected in the formation of a fibrous gingiva that is particularly useful for the tissue arrangement around the implant. Thus, from the initial stage of implant placement, it is possible to achieve a stable gingiva that will last until the prosthetic stage (Figures 13 through 16).

Apart from the clinical stability reflected in the maintenance of osteointegration in the months subsequent to the positioning of implants, radiographs after 1 year show no modification, which would indicate alveolysis around the implant.

Bringing Implants Into Use

Radiofrequency facilitates the freeing of gingival tissue above the implant screw cover when it is brought into use. Until now, the elimination of this tissue has been achieved using a scalpel (blade 15, blade 11) or a cutter. This incision is generally accompanied by a weeping hemorrhage that is obstructive to the surgeon and a source of bacterial contamination.

The use of the electric bistoury is not recommended, owing to the high heat energy emitted above the head of the implant. Radiofrequency microfibers ensure that the mucosa covers are eliminated without hemorrhaging along with a sterilization of the incision surface (Figures 17 and 18).

At this stage, it is thus possible to cut a cylinder in the gingiva down to the base of the implant, whether it is an implant with an external or an internal hexagon. Here again, the contact between the electrode and the surface of the implant head involves neither a rise in temperature nor any electrical shock. It is therefore easy to free the implant head quickly, owing to the extremely good visibility. This is followed by a meticulous check of the adaptation of the scarring rings or prosthetic transfers. The visibility provided by this nonhemorrhaging area facilitates the measurement of the gingival height above the head of the implant, which results in the choice of the most suitable prosthetic components. The scarring of these tissues is reflected by a mucosa with a noninflammatory scarring appearance.

Prosthetic Stage

Two weeks after positioning the scarring rings, the implant casting stage begins. It is always possible to alter the gingival area around the head of the implant in order to obtain the best possible aesthetic appearance of the prosthetic gingival contour. Likewise, when the cast is being taken and when the moulds are put into position, the implant base/mould junction is located in a clear gingival area, making it easier to achieve a more precise print without retraction of the gingival tissues.

Finally, this technique is also of great assistance at the prosthetic stage in the event of a loosening of an abutment or a crown in order to remodel the gingiva prior to taking an additional cast (Figures 19 and 20).

Implant Detachment

The occurrence of peri-implantitis or the loss of implant osteointegration may require the use of radiofrequency. These complications are characterized by the development of hyperplastic, inflammatory, hemorrhaging granulation tissue that significantly conceals the area around the implant. The gradual elimination of these granulation tissues is achieved easily without any hemorrhaging. The cut/coag or coag modes cause the tissues to dry out during the

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operation and achieve optimal scarring owing to the sterile surgical environment, which is essential for these infected areas. Here again, the consequences of the operation are seen to include an almost total absence of hematomas and edemas.

DISCUSSION

High-frequency-current, low-temperature radiosurgery is now used in a wide number of surgical fields (ophthalmology, carcinology, plastic surgery, and otorhinolaryngology), owing to the technical advantages suitable for these types of operations.[11,12] In dentistry, we can make use of these characteristics, including (1) during apical curretages, (2) frenectomies or mucosal cyst excisions, (3) in periodontal procedures such as creating flaps, and (4) of course, in implantology for the cases described in this article.[13,14]

Recent histological analyses in plastic surgery have compared the effects of tissue incisions achieved using a scalpel, electrical bistoury, and radiofrequency. It was observed that after 8, 30, and 60 days, tissue inflammation disappeared in the same proportions with the scalpel and radiofrequency. By contrast, scarring was much higher with the electrical bistoury. Scarring was finer after 60 days with radiofrequency and far more irregular with the electrical bistoury.[7,15,16] In ophthalmology, a significant reduction in tissue lesions was observed for radiosurgery incisions compared with CO_2 laser incisions.[17,18]

These results are similar to those of a comparative study of radiofrequency, CO_2 laser, and Nd:YAG laser on human oocytes, where the extent of tissue degradation was 0.3 mm for radiofrequency, 0.6 mm for CO_2 laser, and 0.8 mm for Nd:YAG laser.[18]

In implantology, there are several operating methods. Owing to its structure, open blade bistoury requires pressure during the incision. Since the blade is rigid, it cannot be easily adapted to all anatomical areas and can be subject to operative risks. The operative area quickly becomes hemorrhagic, and there is no possibility for sterilization of the blade itself during the operation. Laser incisions are achieved through a flexible fiber. Sterilization of the operative field is achieved during the operation, but a greater level of lateral heat is observed. The cost of laser equipment is still high, especially for general practitioners. Electrical bistoury makes significant steps forward in terms of operative accessibility, but low-frequency currents generate a major increase in temperature.[19,20]

In implantology, high-frequency radiosurgery facilitates operations through greater visibility and reduced tissue degradation compared to the other procedures. To date, the absence of high temperature levels makes it possible to prepare the tissue around the implant heads with no clinical or radiographic consequences observed. Histological studies are currently being evaluated.

The ease with which the electrodes can be handled makes this operation particularly suitable for any area.

CONCLUSION

Radiofrequency clearly offers surgical security through a highly precise treatment process and prosthetic phase for implantology. The absence of high temperature levels associated with a nonhemorrhaging incision during the various stages of the implant promote optimal scarring of the tissue surfaces. The ease with which the electrodes can be handled makes this operation particularly suitable for any area.✦

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