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Electrosurgery in Periodontics: An Advent of Invention - A Literature Review

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ABSTRACT

Electrosurgery, also called radiosurgery, has been in the field of dentistry for more than 75 years. More than a century's worth of literature exists on electrosurgery citing its applications in various surgical procedures. In the past three decades, the role of electrocautery has also been well established with a significant rise in minimally invasive and microsurgical techniques. Electrosurgery basically employs two electrodes that deliver the electrical current, the electrosurgical units, and the connecting wires. It works on the principle where the electromagnetic energy is converted into kinetic energy and then into thermal energy that produces the effect of energy with the continuing advent of specifically engineered electrodes, electrosurgery relies on the method of controlled and exact delivery of radiofrequency electrical current to the soft tissue region that creates a desired clinical effect. This desired clinical effect depends on several factors the frequency of the electrical current, the size, the shape of the defect, and the distance between the electrode and the soft tissue site. Almost every area of dentistry employs electrosurgery. Research is ongoing into several novel uses for electrosurgery, which is an area that is always changing.

KEYWORDS: Electrosurgery, Electrocautery, Lateral heat, Monopolar

INTRODUCTION

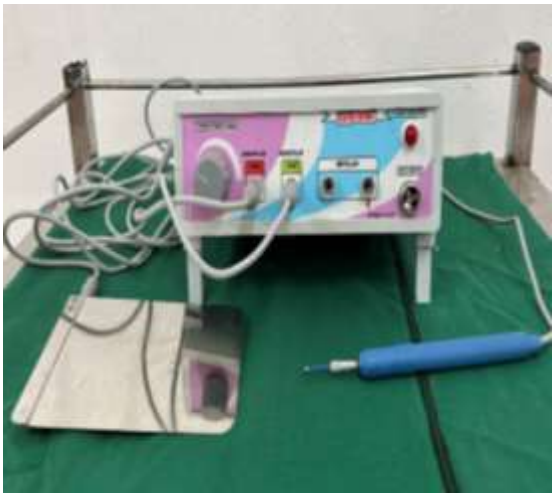
Electrosurgery (ES) has been defined as the intentional passage of high-frequency waveforms, or currents, through the tissues of the body to achieve a controllable surgical effect.[1] With the aid of this high-frequency energy, the tissue is sliced or coagulated. As the electrode travels through the tissue, they cause the tissue to evaporate, and as the tissue shrinks, capillaries on either side of the incision wall are sealed. Thus, the treatment is referred to as "**Bloodless Surgery**."

HISTORY

The initial application of electricity in dentistry and medicine started with the application of spark gap generators (Hyfrecators) (in 1907) [2] and cautery units (in 1909) [3]. The electrosurgical unit was developed by **William T. Bovie** [4] Brigham Hospital, the electrosurgical generator was first used in an operating room on October 1, 1926. Later on, as time went on, this technology underwent a lot of advancements.

PRINCIPLES OF ELECTROSURGERY:

The electromagnetic energy in the tissue is transformed in the cells when radio frequency electrical current is introduced, first into kinetic energy and subsequently into heat energy. The size and shape of the electrode's surface that is in proximity to or in contact with the target tissue, along with other variables like tissue exposure time, affect the desired effect in the tissue. This entire process involves connecting wires, electrodes, the patient, and an electrosurgical machine to create an electrical circuit. (Figure 1)



(Figure 1): Electrocautery unit

There are two types of instruments, bipolar and unipolar. Bipolar instruments have both electrodes positioned on the device, typically one at the distal end, such that the circuit only affects the tissue in between the two electrodes. Only one electrode is mounted on the device in unipolar instruments and the entire patient is sandwiched between this "active electrode" and a substantial dispersive electrode that is likewise coupled to the electrosurgical unit but placed a distance from the target tissue, usually on the back or thigh. The fundamental characteristics of electrical currents, such as the current-voltage (V), impedance, and resistance, determine how much energy is transferred to the tissue during the operation (R).

ELECTRODES

The electrosurgery unit is made up of two electrodes: an active electrode, which serves as the cutting tip of the electrosurgery unit, and a passive electrode, which serves as an antenna to bring the radio signal back to the electrosurgery unit.

As was previously mentioned, passive electrodes serve as an antenna to attract radio-frequency electrical current back to the electrosurgical equipment. The various varieties of passive electrodes are readily available. Included in them are Perma-ground, coated/insulated Passive electrodes, metallic wristbands, and metallic hand-held rods.

Active electrodes: Active electrodes are utilized for coagulating or cutting tissue. They are made in a variety of forms depending on their intended use. Active electrodes that resemble needles are used to cut tissues, whereas electrodes with a large surface area at the tip are utilized to coagulate tissues.

(Figure 2) represents the commonly used electrode tips in dentistry.

{A} Haemostasis ball electrode
{B} Triangular electrode
{C}Scalpel point electrode
{D} Small loop electrode
{E} Haemostasis tip electrode
{F} Large loop electrode
{G} Proximal haemostasis tip electrode

BASIC ELECTRO-SURGICAL TECHNIQUES

- Electrocoagulation: Haemorrhage control is obtained by using the electrocoagulation current.
- Electrosection: Used for incision, excision, and tissue planing.
- Electrofulguration: Used for destroying abnormal tissues like tumors.
- Electrodesiccation: Used to remove basal cell and squamous cell carcinomas.

LATERAL HEAT

A considerable amount of heat is produced by the tissue's electrical wave resistance. Lateral heat is the term given to this heat. There is a connection between lateral heat generation and wave quality. To calculate the quantity of lateral heat production, use the formula below.

Lateral heat = T + AC + EF + CS / TI

LH = Lateral Heat.
T = Time.
AC = Amplitude of Current.
FE = Electrode Form.
CS = Current Selection.
TI = Tissue Impedance.

With various waveforms, a varying amount of lateral heat is produced. The waveform is selected based on the intended outcome for the tissue. The amount of lateral heat created decreases when the active electrode is moved over the tissue more quickly. No more than one to two seconds must pass between the active electrode and the tissue.

In one investigation, the rise in tissue temperature was used to evaluate the formation of lateral heat by different waveforms. They discovered temperature increases of 5 to 86° F that was influenced by the current type, application time, and distance from the electrode [5]. Another investigation revealed that the time of the incision had an impact on the amount of heat produced laterally near a fine wire needle electrode that was transmitting a completely rectified current. [6] The authors of this study showed that in order to prevent the damaging effects of lateral heat on the tissue, there should be a minimum of 8 seconds between each subsequent incision in the same area. In a different investigation, the same authors showed that this time interval varied depending on the active electrode employed. They discovered that during surgery, an activated loop electrode produced more energy than a needle electrode. They used a loop electrode to show that a cooling break of 15 seconds was required to effectively disperse the heat between repeated entries into the same location of the tissue. [7]

ADVANTAGES

- Minimal bleeding occurs post-incision.
- The surgical site is visibly clear.
- Can be used in difficult-to-reach areas.
- Minimal scar formation is evident.
- Better post-operative healing.
- Less operator fatigue and chair time are reported during the surgical operation.
- The technique is pressureless and precise.
- The procedure has no sutures as the healing occurs by secondary intention.
- Soft tissue planing can be done.

DISADVANTAGES

- The cost of the electrosurgery unit is high.
- Bad odor of soft tissue burning is present if high-volume suction is not used.
- If the electrode tip touches the bone, necrosis occurs.

INDICATIONS

- Incision and Drainage of abscesses
- Hemostasis
- Biopsy
- Troughing of crown and bridge impressions
- Tuberosity reduction

CONTRAINDICATIONS

- Contraindicated in patients with pacemakers.

- Cannot be used near inflammable gasses.

POST-OPERATIVE INSTRUCTIONS

- After surgery, the patient should refrain from smoking, consuming hard or spicy meals, drinking citrus drinks, and using tobacco products.
- When cleaning regions that are not being operated on, use a toothbrush cautiously.
- Analgesics might be provided since it is common to feel some discomfort after electrosurgery.
- The person must be told to apply cold packs to the region to reduce swelling after a lengthy surgery.
- Patients should be instructed to call if an issue emerges.

WOUND HEALING IN ELECTROSURGERY

Following electrosurgery, the way tissue heals depends on the lateral thermal damage and accompanying tissue necrosis brought on by the use of electrical energy. Lower current densities and shorter exposure times result in more damage, while higher current densities and longer exposure times result in less. The power output [8] and frequency [9] of the electrosurgical machine have an impact on the histological results of the procedure. The waveform selected [10] and the size and shape of the active electrode [11]. It has been demonstrated that electrosurgical devices with lower frequencies alter tissue more than those with higher frequencies.

In one study, postoperative wound healing using an electrosurgical device and a scalpel was compared. Findings showed that utilizing electrosurgery equipment slowed recovery when compared to using a scalpel. More tissue deterioration and inflammation were visible in the electrosurgical treated site. The osteoblastic activity, on the other hand, was the same in both instances, demonstrating the same bone response [12]. Another study examined the rate of recovery following periodontal knife versus electrosurgery. Results, when gingival excision was sallow, did not change. Nonetheless, there was a bone loss in deep wounds from bone necrosis, which was more common in electrosurgery cases. [13]

It should be noted that the type of waveform utilized and the type of surgical technique performed affect how the wound heals during electrosurgery.

GUIDELINES FOR THE USE OF ELECTROSURGERY:

Krejci et al [14] have provided the following clinical guidelines that should be employed during electrosurgery:

- A fully rectified filtered waveform at a higher frequency should be used to create intraoral incisions.
- The incision should be made with the smallest electrode possible.
- Electrosurgical incisions should be made at a minimum rate of 7 mm/s.
- A cooling period of 8 seconds should be allowed between successive incisions with a needle electrode at the same surgical site. For excisional procedures with loop electrodes, the timings should be increased to 15 seconds.
- In areas where connective tissue reattachment is required, contact of the active electrosurgery electrode to the cemental surface of a tooth must be avoided.
- In metallic restorations, the contact of an active electrosurgery electrode should be confined to times shorter than 0.4 seconds. Pulpal necrosis may develop as a result of prolonged contact.
- Electrosurgery should only be used after all other clinical options have been exhausted in order to provide fulgurating sparks for use in achieving hemorrhage control. Following the use of fulguration, a delayed healing response is expected.
- Excision of inflammatory papillary hyperplasia can be done with electrosurgery in a safe and convenient manner.

Applications Of Electrosurgery For Various Procedures In Periodontology:

Electrosurgery gives an added arm for soft-tissue management in periodontology. A review of the literature disclosed that ES is utilized for various procedures such as

1) Gingivectomy,
2) Gingivoplasty,
3) Crown lengthening,
4) Minimally invasive closed osteotomy,
5) Frenectomy,
6) Operculectomy,
7) Depigmentation,
8) Gingival curettage,
9) Periodontal flap procedures,
10) Mucogingival surgeries,
11) Harvesting soft-tissue grafts,
12) Implantology.

- Devishree, et al. In 2012[15] showed a number of clinical frenectomy cases that were treated utilizing a number of techniques, including Miller's technique, V-Y plasty, Z plasty, and electrocautery. Of all the methods, electrocautery had the advantage of minimal chair side time with a clear view of the surgical site and requiring no wound closure with sutures.
- Reddy NR, et al. In 2014 (16) presented a case series of ankyloglossia management using a scalpel, laser, and electrocautery. This clinical study indicated that laser and electrocautery treatment used for lingual frenectomy operations provided better outcomes in terms of patient's pain perception and function postoperatively than that obtained by the scalpel technique.
- Cholan PK, et al. In 2014 (17) used Electrocautery as a medium to harvest FGG for gingival augmentation to increase the width of the attached gingiva. Their case report resulted in better healing at the donor site.
- Bhullar SK, et al. In 2017 (18) did a Comparative evaluation of pain in vestibular depth extension procedure using a scalpel, electrocautery, and diode laser and stated that electrocautery provides better patient perception in terms of pain and discomfort than that obtained by the scalpel and laser techniques.
- Anjhana Ashok, et al. In 2018 (19) showed a number of operculectomy treated with different techniques like scalpel, laser, and electrocautery. Of all methods, Laser and Electrocautery showed better results in terms of patient comfort.
- Puri SS, et al. In 2019 (20) did a comparative evaluation between electrosurgery and free gingival graft in the treatment of gingival hyperpigmentation where electrosurgical technique, as well as FGG, were found to be effective in reducing the gingival pigmentation. No recurrence was seen with either of the procedures up to 3 months post-operatively. However, there was less post-operative discomfort and pain in an electrosurgical group as compared to FGG.
- Park, et al. In 2019 (21) introduced a technique to eliminate failed dental implant fixtures using monopolar electrocautery. And concluded that Monopolar electrocautery can be considered an alternative method for removing failed or poorly positioned dental implants without the need to grind the bony tissue surrounding the implant fixture.
- Ahmed Dardir Mohamed, et al. In 2020 (22) did a split-mouth, randomized controlled trial in 10 patients for the Management of gingival enlargement with Laser and Electrocautery. They concluded that Electrocautery was superior to diode laser regarding postoperative pain and diode laser has an advantage over electrocautery regarding instrument performance and showed better improvement in the healing process.

CONCLUSION

As more advanced electrosurgical equipment is created with a focus on dental use, electrosurgery in dentistry is growing. No matter whichever electrosurgery method is employed, there will always be some level of lateral thermal damage, but it may only affect small regions. It must be understood, however, that electrosurgery will never be able to fully replace the scalpel. The benefits of both can be

combined by clinicians to provide patients with the greatest outcomes possible.

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