Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691**
Sch. J. App. Med. Sci., 2013; 1(5):530-534
©Scholars Academic and Scientific Publisher
(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Review Article

Electrosurgical applications in Dentistry

Dr. Pallavi Samatha Yalamanchili[1*], Dr. Pavithra Davanapelly[2], Dr. Hemchand Surapaneni[3]
[1]Reader, Department of Periodontics and Implantology, Drs. Sudha & Nageswara rao Siddhartha institute of Dental Sciences, Chinnaoutpally, Gannavaram mandal, Krishna dist; Andhra pradesh-521286.
[2]Post graduate, Department of Periodontics and Implantology, Drs. Sudha & Nageswara rao Siddhartha institute of Dental Sciences, Chinnaoutpally, Gannavaram mandal, Krishna dist; Andhra pradesh-521286.
[3]Reader, Department of Prosthodontics, Drs. Sudha & Nageswara rao Siddhartha institute of Dental Sciences, Chinnaoutpally, Gannavaram mandal, Krishna dist; Andhra pradesh-521286.

Corresponding author
Dr. Pallavi Samatha Yalamanchili
Email: pallavi_yalamanchili@yahoo.co.in

Abstract: Electrosurgery which can also be called as radiosurgery has been used in dentistry for more than 50years. Electrosurgery is a controlled precise application of radiofrequency electrical current to the soft tissue site to be cut which is achieved by means of carefully designed electrodes. Electrosurgery is used in almost all branches of dentistry. Electrosurgery is a continuously evolving field with active research into various new applications.
Keywords: Electrosurgery, waveform, lateral heat, wound healing, coagulation, bipolar

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]. By varying the mode of application of this type of current, the clinician can use ES for cutting or coagulating soft tissues.

Many credit "Bovie" as the father of electrical devices. He developed the modern-day instrument and helped bring it to the forefront of the profession. The use of cautery dates back as far as prehistoric times, when heated stones were used to obtain hemostasis. Goldwyn described three eras encompassing the development of the modern electrosurgical technology [2]. The first era began with the discovery and use of static electricity. The second era, best called "galvanization," evolved from Luigi Galvani's accidental discovery in 1786. He noted that muscle spasms were induced in frogs' legs hanging from copper hooks. The third era, dating to 1831, was ushered in with discoveries by Faraday and Henry in England and America, respectively, who almost simultaneously showed that a moving magnet could induce an electrical current in wire. In 1881, Morton found that an oscillating current at a frequency of 100 kHz could pass through the human body without inducing pain, spasm, or burn. Franz Nagelschmidt, in 1897, discovered that patients with articular and circulatory ailments benefited from the application of electrical currents. During the early 1900s, Simon Pozzi used high frequency, high-voltage, low-amperage currents to treat skin cancers. In 1928 William Cameron developed the first dental electrosurgical unit.

Electrosurgery or radiosurgery techniques and instrumentation

There are three classes of electrodes: single-wire electrodes for incising or excising; loop electrodes for planing tissues and heavy, bulkier electrodes for coagulation procedures (figure 1). The four basic types of electrosurgical techniques are electrosection, electrocoagulation, electrofulguration, electrodessication.

Fig. 1: Electrosurgical unit with different types of electrodes.

Electrosection, also referred to as electrotomy or acusection, is used for incisions, exisions, and tissue planing. Incisions and excisions are performed with single-wire active electrodes that can be bent or adapted to accomplish any type of cutting procedure. Electrocoagulation provides a wide range of coagulation or hemorrhage control by using the electrocoagulation current. The active electrodes used for coagulation are much bulkier than the fine tungsten wire used for electrosection. The other two techniques, electrofulguration and electrodesiccation are not used in general dentistry. Electrosurgical technology offers two types of devices for energy delivery: monopolar and bipolar. Both types of these units achieve their intended purposes well, but monopolar is used more than bipolar.

Variables affecting electrosurgery performance
Lateral heat

When the active electrode tip contacts the tissue, the electrode itself does not produce any significant heat; rather the intense heat that is required for the electrosurgical effect is generated within the tissues that are contacted by the electrode tip. While this intracellular heat causes disruption of cells at the line of incision and/or coagulation, some of it also spreads to the adjacent cell layers. This heat is called the lateral heat. Lateral heat causes coagulation necrosis on the cell layers adjacent to all incision sites. However, this necrosis is minimal, and any unwanted tissue destruction is caused by excess lateral heat. Therefore, when ES is performed, the main objective is to produce a clean incision or/and coagulation with minimal lateral heat.

Kelly & Harrison [3] measured lateral temperatures in soft tissue following exposure to different types of electrosurgical currents. They found temperature rises of 5 to 86^{o}F dependent upon the type of current, time of current application and the distance from the electrode.

Stevens et al.[4] demonstrated extremely large increases in lateral heat adjacent to electrosurgery electrodes activated within dog gingiva. The group however did not control many technique variables and the active electrode was left in contact with tissue for time periods much longer than would be used clinically.

Kalkwarf et al. [5] showed that lateral heat production adjacent to a fine wire needle electrode emitting fully rectified-filtered current was dependent upon the time of incision. They also demonstrated that three successive incisions into the same site dramatically increased the amount of lateral heat production (8.0 - 48.0^{o}C) at a distance of 1 mm from the electrode. The authors demonstrated that a cooling period of at least 8 seconds between subsequent incisions in the same area is necessary to assure that lateral heat production capable of initiating adverse tissue responses does not occur. The same group, in a separate study, found that an activated loop electrode generated more energy during surgery than a needle electrode [6]. Temperature increases in the adjacent tissue following use of the loop remained for longer periods of time than after use of a needle electrode. They calculated that a cooling interval of 15 seconds was necessary to properly dissipate heat between successive entries into the same area of tissue with a loop electrode.

Size and type of active electrodes

The thicker the electrode, the greater the amount of lateral heat. In a study of electrosurgical wounds, it was reported that the needle-type electrode, which is used for incisions, creates a 0,12-mm-wide necrosis, and the loop electrode, used for tissue planing, makes a 0.31-mm-wide necrosis [7]. The same report also concluded that large electrodes cause more tissue damage than small ones.

Wave form

The choice of waveform depends on (1) the required Surgical effect, i.e., whether tissue separation or hemostasis is required, and (2) the proximity of bone to the surgical site. The fully rectified waveform produces excellent tissue separation with the least amount of lateral heat, but it also produces very little hemostasis. The fully rectified, unfiltered waveform produces good tissue separation with effective hemostasis. The partially rectified waveform produces much more lateral heat than the fully rectified, unfiltered waveform: therefore it can be used only for the control of hemorrhage in soft tissue.

Cutting time

The quicker the active electrode is passed over the tissue, the lesser the lateral heat. It has been estimated that to generate an effective incision, while keeping the lateral heat at a minimum level, the electrode must be guided over the tissue at a speed of 7 mm/s[8]. The active electrode must not remain in contact with tissue for more than 1 to 2 seconds at a time and successive applications of the electrode on the same spot must have a 10 to15 seconds interval. This interval allows the heat produced on the wound to dissipate and prevents overheating of the tissue surface before the next application of the electrode**.**

Surface tissue condition

The surface of the tissue must be moist to allow heat dispersal. A dehydrated tissue surface causes .sparking, tissue drag, and delayed healing [9]. Therefore, it is desirable for the tissue surface to be wetted with the patient's own saliva or water or saline. Irrigation of the surgical site immediately after ES will also help to minimize lateral heat.

Indications

- Elongation of clinical crowns
- Gingivectomies and gingivoplasties
- Frenectomies
- Operculectomies
- Incision and drainage of abscesses
- Hemostasis
- Troughing of crown and bridge impressions
- Tuberosity reduction
- Biopsies (incisional and excisional)
- Periodontal pocket reduction

Contraindications

- A patient with pace maker cannot be treated with monopolar electrosurgery.

- Should not be used for procedures that involve proximity to the bone.

Advantages

- A clear view of the surgical site is provided.
- Tissue separation is clean with little or no bleeding.
- The technique is pressureless and precise.
- Planing of soft tissue is possible.
- Healing discomfort and scar formation are minimal.
- Access to difficult-to-reach areas is increased.
- Chair time and operator fatigue are reduced.

Disadvantages

- Cannot be used on patients with poorly shielded pacemakers.
- Electrosurgery units cannot be used near inflammable gases.
- The odor of burning tissue is present if high-volume suction is not used.
- The initial cost of the ES equipment is far greater than the cost of a scalpel.

Safety precautions

- Do not use near flammable gases.
- Use lowest current setting.
- Do not use cautery blade as retractor.
- Use suction to remove smoke.

Post-operative instructions

- The patient should avoid smoking, eating of hard or spicy foods, citrus juices and alcohol following surgery.
- A toothbrush may be carefully used in areas not involved with the surgical procedure.
- Following electrosurgery, it is normal to experience some discomfort; therefore analgesics can be prescribed.
- To control swelling areas of extensive surgery, the patient should be instructed to apply ice packs to the area.
- Patients should be instructed to call if any problem arises.

Guidelines for use of Electrosurgery

Krejci et al [10] have provided the following clinical guidelines.

- Incision of intraoral tissues with electrosurgery should be accomplished with a higher frequency unit tuned to optimal power output and set to generate a fully rectified-filtered waveform.
- The smallest possible electrode should be selected to accomplish the incision.
- 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. The period must be increased to fifteen seconds when a loop electrode is utilized for excisional procedures.
- The clinician should anticipate a slight amount of gingival recession when an electrosurgical incision is used for troughing or excision of the gingival crevice.
- Contact of the activated electrosurgery electrode to the cemental surface of a tooth must be avoided in regions where connective tissue reattachment is desired
- Intermittent contact of an active electrode delivering a well-controlled current to alveolar bone will initiate only slight osseous remodeling which will not result in clinical changes. Incorrect current control or extended contact with alveolar bone may produce irreversible changes capable of resulting in diminished periodontal support.
- Contact of an active electrosurgery electrode with metallic restorations should be limited to periods less than 0.4 seconds. Longer periods of contact may result in pulpal necrosis.
- Electrosurgery may be used effectively for pulpotomy procedures.
- Use of electrosurgery to provide fulgurating sparks for use in obtaining hemorrhage control should be used only after all other clinical methods have been tried. A delayed healing response following the use of fulguration should be expected.
- Electrosurgery may be used safely and conveniently to excise inflammatory papillary hyperplasia.

Applications of electrosurgery for various procedures in dentistry

Devishree, et al [11] had presented a series of clinical cases of frenectomy which were approached by various techniques, like Miller's technique, V-Y plasty, Z-plasty and frenectomy by using electrocautery. Among all the procedures, electrocautery offered the advantage of minimal time consumption and bloodless field during the surgical procedure, with no requirement of sutures.

Verco P.J.W [12] had presented a case report on management of tongue tie using argon beam electrocautery in children. An 8 year old girl with lingual tongue tie showing restricted movement was treated using ExplorAr plasma cutting electrode. Postoperative results showed uneventful healing with little or no post-operative pain and lack of eschar at 4 months follow up.

Gregori M, Kurtzman, and Lee H. Silverstein [13] had presented a case report on usage of bipolar electrocautery for gingival modification in passive eruption cases. A female patient with excessive gingival display was treated using Bident Bipolar 3303 gingivectomy handpiece to remove excess gingival and to taper the gingival margin to ideal contour. A 4 week postoperative examination demonstrated a more aesthetic smile with improved width-crown proportions and elimination of excessive gingival display.

Kusum Bashetty et al [14] presented a series of casereports where monopolar electrosurgery unit was used for gingival recontoring, excision of gingival tissue extending into carious lesion**,** excision of gingival tissue extending into fractured area of the tooth suggesting electrosurgery to be of immense use in clinical dentistry.

G J Livaditis [15] had presented a clinical report on vital pulp therapy with bipolar electrocoagulation after intentional pulp exposure of fixed prosthodontic abutments. The protocol included a definitive cavity preparation to create space in the exposed dentin for an adhesive pulp barrier and the use of precise bipolar electrocoagulation to provide durable hemostasis for restoration of the pulp wall and a relatively clot-free surgical wound to facilitate healing followed by application of gentle surgical and restorative procedures to support the inherent healing process to restore the health of the pulp.

Glickman and Imbert [16] compared the effect of gingival resection with electrosurgery and periodontal knives. Electrosurgery was used on the right side, whereas the scalpel surgery was carried out on the left side. Two types of laceration were evaluated, the deep and the shallow resection. Results showed electrosurgery when performed with deep resection can result in extensive gingival recession, bone necrosis and furcation involvement when used close to the bone where as such did not occur followed the use of periodontal knives.

Aremband and Bryan Wade [17] studied wound healing in gingivectomy with electrosurgery and knives in 27 patients. Results revealed that there was no observable difference between the two modalities following three week post operative period. Pain was insignificant and experienced equally in both modalities and cytological evaluation revealed no difference in both connective tissue and epithelial maturity in both modalities suggesting electrosurgery can be effectively used for gingivectomy procedures.

Pope [18] found that repair following electrosurgery persists for much longer time when compared to the scalpel surgery. He conducted a split mouth design, on four mongrel dogs with electrosurgery procedure on the left side and the scalpel surgery on the right side of the mouth. The results indicated that there is more severe and greater degree of bone injury, indicated by a larger number of osteoclast and osteoblasts in the areas where electrosurgery was done.

Ian E. Shuman [19] had presented a case series on clinical applications of electrosurgery. Here bipolar electrosurgery was used in circum coronal gingivoplasty, caries access and exposure, implant exposure and frenectomy. Results showed uneventful healing with no post-operative complications.

Jeffrey A, Sherman [20] had treated a 52 year old female patient with slight soft tissue over growth around implants with a straight, bipolar electrode to incise tissue and expose the implant fully.

Electrosurgery can be used to perform gingivectomy and gingivoplasty. However, extra caution must be carried out to avoid contact with the bone since irreparable damages will occur. The only advantage of electrosurgery today is the coagulation to reduce bleeding and resulting in a clean field with better visibility for the surgery.

CONCLUSION

Electrosurgery can never completely replace the scalpel but it requires more knowledge, skill and complete understanding of the biophysical aspects of the interaction of electrosurgical energy and tissue. Continued research into the area of tissue interaction shows promise in the potential development of novel applications of electrosurgery.

REFERENCES

1. Osman FS; Dental electrosurgery: Genera! precautions. Can Dent Assoc J, 1982; 48:642.
2. Goldwyn RM. Bovie:The man and the machine. Ann Plast Surg 1979;2:135–153.
3. Kelly WJ, Harrison JD; Heat generation and penetration in gingival tissues using electrosurgical currents. In: Electrosurgery in dentistry, Oringer, M. J. (ed.) 2nd edition, 1975; 154-176.
4. Stevens V, Weil J, Simon B, Schuback P, Deasey M; Quantitative analysis of heat generated during electrosurgery. Journal of Dentat Research, 1981; 60(126): 432.
5. Kalkwarf KL, Krejci RF, Edison AR, Reinhardt RA; Lateral heal production secondary to e!ectrosurgery incisions. Oral Surgery, Oral Medicine and Oral Pathology, 1983b; 55:344-348.
6. Kalkwarf KL, Krejci RR, Edison AR., Reinhardt RA; Subjacent heat production during tissue excision with electrosurgery. Journal of Oral and Maxillofacial Surgery, 1983a; 41:653-657.
7. Noble WH, McClatchey DD, Douglas GD. A histological comparision of effects of electrosurgical resection using different electrodes, J Prosthet Dent ,1976;35:575-579.

8. Kalkwarf KL. Krejci RF. Shaw DH. Edison AR, Histologic evaluation of gingival response to an electrosurgical blade, J Oral Maxillofac Surg l987;45:67l-674.
9. Flocken JE; Electrosurgical management of soft tissues and restorative denlistry. Oral Health, 1980;70:35-40.
10. Krejci RF, Kalkwarf and Krause-Hohenstein U; Electrosurgery – a biological approach. J Clin Periodontol, 1987;14;557-563.
11. Devishree, Sheela Kumar Gujjari, Shubhashini P.V Frenectomy: A Review with the Reports of Surgical Techniques**.** Journal of Clinical and Diagnostic Research, 2012;6(9):1587-1592.
12. Verco PJW; Case report and clinical technique: argon beam electrosurgery for tongue ties and maxillary frenectomies in infants and children. European archives of Paediatric dentistry, 2007; 8 (suppl. 1)
13. Gregori M, Kurtzman, Lee H; Silverstein Bipolar Electrosurgery: Gingival Modification in Passive Eruption Cases. Dent Today, 2008; 27(8):112-114
14. Kusum Bashetty, Gururaj Nadig, Sandhya Kapoor; Electrosurgery in aesthetic and restorative dentistry: A literature review and case reports. J Conserv Dent, 2009;12:139-44.
15. Livaditis GJ; Vital pulp therapy with bipolar electrocoagulation after intentional pulp exposure of fixed prosthodontic abutments: a clinical report. J Prosthet Dent, 2006; 86 (4):400-406.
16. Glickman I, Imber L; Comparision of gingival resection with electrocautery and periodontal knives- a biometric and histologic study, journal of Periodontology, 1970;142,
17. Aremband D, Wade AB; A comparative wound healing study following gingivectomy by electrosurgery and kives, Journal of Periodontal Research, 1973;8:42,
18. Pope JW, Garginlo AW, Staffileno H, Levy S; Effects of electrosurgery on wound healing in dogs. Periodontics, 1968; 6:30-37.
19. Shuman IE; Bipolar Versus Monopolar Electrosurgery: Clinical Applications, Dent Today, 2001;20:74-81.
20. Jeffrey A, Sherman; Implant exposure using radiosurgery, Dentistry today. 2007; 26(4):92-96.