

A Comparative Study of Electro-Surgery & Scalpel Surgery

Dr. Naresh Sharma

Assistant Professor
Dept of Pedodontics & Preventive Dentistry
Manav Rachna Dental College, Faridabad

Dr. Sachin Dev Sachdeva

Associate Professor
Dept of Oral & Maxillofacial Surgery
MMDC, LNM University, India

Abstract

Thirty human patients participated in a study designed to compare electro surgery with steel scalpel for incision for pre-prosthetic surgeries and impacted lower third molar surgeries under local anesthesia. All the cases were evaluated for Bleeding and Incisional time intra-operatively, Pain and Healing of the surgical site post-operatively. The mean blood loss for electro-surgery was very less as compared with scalpel surgery. The difference in blood loss was statistically highly significant ($p < 0.001$). The mean time taken for incision and elevation of mucoperiosteal flap was less for electro surgery than that of scalpel surgery and this difference was statistically significant ($p = 0.015$). Healing occurred at approximately the same rate following each procedure. The majority of subjects did not perceive a difference in pain with either technique at any time during follow-up.

Keywords: Electro surgery; Scalpel; Wound healing.

Heating of tissues has been used for thousands of years to treat a variety of conditions or to help stop bleeding from a wound. Hippocrates suggested that heat was often a predominant manifestation of disease and could be used to treat joint problems and haemorrhoids. Medieval warriors used heated stakes to treat bleeding injuries. It was not until the late 19th century, however, that a French physicist named d'Arsonval introduced electrical current flowing through the body as a way of producing heat in tissue. The first electro-surgical generator to be widely accepted by physicians was produced through the collaboration of a physicist and a surgeon. At Harvard in 1926, a physicist named William T. Bovie (1882-1958) developed an electro-surgical device to aid in the removal of tumors.^{1,2}

Electro-surgery (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. By varying the mode of application of this type of current, the clinician can use ES for cutting or coagulating soft tissues. Tissues are naturally resistant to high-frequency waveforms; when these waveforms pass through it, intense intracellular heat is produced within the tissues contacted by the active electrode tip. This heat volatilizes cells, and as the electrode is guided through the tissue, it leaves a path of cell destruction in the form of an incision or surface coagulation.³

Conventionally a scalpel has been used to make a surgical incision because of its ease

of use, accuracy, and minimal damage to adjacent tissue. The need for hemostasis in highly vascular areas such as the head and neck region led to the widespread use of electro-surgery. Therefore, since its introduction in the early part of the 20th century, electro-surgery has been widely used as an alternative tool for creating an incision. The potential benefits of electro-surgery include reduced blood loss, dry and rapid separation of the tissue, and a possible decreased risk of accidental injury caused by the scalpel to operative personnel.^{4,5}

Electro-surgical and manual scalpel cutting differ not only in methods of instrumentation but also in tissue reaction and healing response. Speed is not a factor in scalpel cutting. Cutting is produced by manually forcing the blade into the tissues, crushing the cells in its path. Bleeding, often profuse and persistent, accompanies the cutting. The traumatic tissue cleavage heals with characteristic scar tissue repair. Clinical (surface) healing often is more rapid than healing in the deeper structures. Contaminated surgical fields remain contaminated. Split-thickness skin graft protection of the surgical field often is needed to prevent obliterative contractile scar tissue adhesions.⁴

Speed is an essential factor in electro-surgical cutting (electro-section). Cutting results from disintegration and volatilization (vaporization) of the cells in the path of the current. Bacteria, spores, fungi or yeasts that contaminate the surgical field are also volatilized, sterilizing the field as cutting occurs. Tissue cleavage is totally atraumatic. Electro-section with radio-frequency current seals capillaries as they are severed, producing effective hemostasis. Other clinical benefits derived from the atraumatic procedure and sterile field include: 1) absence of typical postoperative sequelae such as pain, swelling and trismus; and 2) rapid uneventful healing by primary and secondary intention without scar tissue formation. Healing tends to be uniform throughout the depth of the wound. The favorable healing is attributable, in part, to the lack of tissue trauma, and in part, to absence of bacteria and other contaminants that tend to disrupt blood clot organization and delay or disrupt the healing process. Skin graft protection of the surgical site is not needed, even when healing occurs through secondary granulation repair.⁴

Minor oral surgical procedures are, traditionally, carried out with the help of scalpel/ B.P. blades, used for incising the tissues. The use of scalpel is the most commonly used technique for oral surgeries due to its proven success since centuries and

inexpensive nature without the need of additional equipments. However, considerable intra-operative bleeding due to severing of blood vessels and post surgical scarring are the major drawbacks with the use of scalpel/ B.P. blade.⁴

Atraumatic tissue cleavage and sterilization of the wound eliminate unfavourable postoperative sequelae common to scalpel surgery and contribute materially to rapid, uneventful postoperative healing. The ability to incise tissue precisely without use of pressure and effective hemostasis make possible sophisticated oral surgery procedures that cannot be duplicated safely by scalpel surgery.⁴

Although electro-surgery has been used in dentistry for more than 50 years, both opponents and advocates of electro-surgery have presented a variety of clinical studies in favour of their respective opinions.³ Electro-surgery has several applications in almost all branches of dentistry, but this technique is not very widely used. The presence of conflicting and sometimes confusing information on electro-surgical wound healing in the dental literature is the most likely reason. Although some reports have focused on the negative aspects of ES,^{7,8,9} there are as many reports that have shown that there is no difference in the clinical healing of ES and scalpel wounds.^{10,11,12,13,14}

After reviewing the advantages and limitations of electro-surgery over scalpel surgery, a sincere effort has been made in the form of a prospective clinical study to compare electro-surgery and scalpel surgery in minor oral surgical procedures and the efficacy of both these methods are evaluated in the larger interest of the patients.

Methods & Materials

Thirty healthy adults volunteers underwent incision with electro-surgery and steel scalpel for bilateral pre-prosthetic surgeries having similar clinical presentations and bilaterally symmetrical impacted lower third molar surgeries under local anesthesia. On site A-incision and elevation of mucoperiosteal flap was performed by electro-surgery while on site B-incision and elevation of flap was performed by No. 15 stainless steel scalpel. All the cases were evaluated for - bleeding and incisional time intra-operatively, pain post-operatively (2nd post operative day, 1st and 4th post operative week) and healing of the surgical site post-operatively (1st and 4th post operative week).

The subjects were systemically healthy and none of the subjects reported recent use of mood-altering drugs or analgesics or having

electric pacemaker.

A standard performa was used to collect necessary information regarding each case after inclusion. The patients were informed about the study and necessary consent was taken from them. All necessary preoperative, intraoperative & postoperative photographic records were maintained for these patients. And all treatments were performed on an outpatient basis under local anaesthesia. Isolation of surgical site was done with cotton rolls so that saliva does not interfere with evaluation of blood loss. Cleaning of the surgical site was done with topical antiseptic Povidone iodine solution 5% and local anaesthesia was achieved by injecting 2% lidocaine hydrochloride with 1:80,000 epinephrine. Sutures were given with round body 3-0 black silk (Mersilk) after surgery and same post-operative analgesics and antibiotics were prescribed for all.

Blood loss was evaluated by weighing gauze pieces pre-operatively and post-operatively with digital weighing machine⁹² and **Incisional time** was measured with the help of a stop watch from the time of incision till the elevation of mucoperiosteal flap. Patients were evaluated for **Pain** with the help of Visual Analog Scale (VAS), with 0 = no pain and 10 = worst pain possible on 2nd post-operative day, 1st week and 4th week). **Healing** was assessed on 1st week and 4th week post-operatively using following "Healing scoring system".

Results

Bleeding evaluation

Table 5.1 - Comparing the bleeding in electrosurgery and scalpel surgery using Mann- Whitney U test.

3 Good	- No inflammation present.
	- No signs of infection, no wound gaping present.
	- Colour of scar matches the surrounding mucosa.
2 Satisfactory	- Mild to moderate inflammation.
	- No signs of infection, no wound gaping.

1 Bad	- Severe inflammation.
	- Wound gaping present.
	- Other signs of infection present (pus, slough, fever lymphadenopathy).

The mean blood loss for electrosurgery was very less (1.5858 ml) as compared with scalpel surgery (4.1619 ml). This difference in blood loss was statistically highly significant (p<0.001) when comparing both of them.

Incisional Time Evaluation

Table 5.2 - Comparing incisional time for electrosurgery and scalpel surgery using Mann- Whitney U test.

Incisional Time				
Group	N	Mean	Std. Deviation	Z
Electro Surgery	30	5.1373	1.40995	2.44100
Scalpel Surgery	30	6.5578	2.05070	p=0.015 sig

The mean time taken for incision and elevation of mucoperiosteal flap was less for electrosurgery (5.1373 minutes) than that of scalpel surgery (6.5578 minutes) and this difference was statistically significant (p=0.015). It can be attributed to better visibility provided by electrosurgery by achieving adequate hemostasis.

Pain Evaluation

Pain was evaluated with the help of Visual Analog Scale (VAS), with 0 = no pain and 10 = worst pain possible on 2nd post-operative day, 1st week and 4th week .

Table 6.1 - Comparing pain for electrosurgery and scalpel surgery using Chi- square Test on 2nd post-op day.

		GROUP		
		Electro Surgery	Scalpel Surgery	Total
.00	Count	2	2	4
	%	6.7%	6.7%	6.7%
1.00	Count	1	1	2
	%	3.3%	3.3%	3.3%
2.00	Count	12	10	22
	%	40.0%	33.3%	36.7%
3.00	Count	11	12	23
	%	36.7%	40.0%	38.3%

4.00	Count	4	5	9
	%	13.3%	16.7%	15.0%
Total	Count	30	30	60
	%	100%	100%	100%

a. X2=0.336 p=0.987 ns

Table 6.2 - Comparing pain for electrosurgery and scalpel surgery using Chi-square Test on 1st post-op week.

		GROUP		
		Electro Surgery	Scalpel Surgery	Total
.00	Count	10	8	18
	%	33.3%	26.7%	30.0%
2.00	Count	16	17	33
	%	53.3%	56.7%	55.0%
3.00	Count	4	5	9
	%	13.3%	16.7%	15.0%
Total	Count	30	30	60
	%	100%	100%	100%

a. X2=0.334 p=0.834 ns

Table 6.3 - Comparing pain for electrosurgery and scalpel surgery using Chi-square Test on 4th post-op week.

		GROUP		
		Electro Surgery	Scalpel Surgery	Total
.00	Count	25	16	51
	%	83.3%	66.7%	85.0%
1.00	Count	4	4	8
	%	13.3%	13.3%	13.3%
3.00	Count	1	0	1
	%	3.3%	.0%	1.7%
Total	Count	30	30	60
	%	100%	100%	100%

a. X2=1.02 p=0.601 ns

The post-operative pain values in all the three post-operative visits were almost same in both electro-surgery and scalpel surgery sites. The difference in pain in both the sites was not significant statistically at all post-operative visits .

Healing Evaluation

Table 7.1 - Comparing healing for electrosurgery and scalpel surgery using **Chi-square Test** on 1st post-op week.

Scar 1 Week				
		GROUP		Total
		Electro Surgery	Scalpel Surgery	
Satisfactory	Count %	30 100%	30 100%	60 100%
Total	Count %	30 100%	30 100%	60 100%

Table 7.2 - Comparing healing for electrosurgery and scalpel surgery using **Chi-square Test** on 4th post-op week.

Scar 4 Week				
		GROUP		Total
		Electro Surgery	Scalpel Surgery	
Satisfactory	Count %	1 3.3%	0 .0%	1 1.7%
Total	Count %	30 100%	30 100%	60 100%

a. p=1 ns

The difference in healing in both 1st week and 4th week post-operatively was statistically not significant for both the sites. Although there was slightly more inflammation at the electro-surgical site as compared to scalpel surgical site in the 1st post-op week; by the end of 4 weeks, healing was good at both the sites. Only one patient out of thirty had delayed healing at the electro-surgical site which can be attributed to excess use of electro-cautery to achieve hemostasis in that particular case.

Discussion

Minor oral surgical procedures are traditionally carried out with the help of scalpel for incising the tissues. The use of scalpel is the most commonly used technique for oral surgeries due to its proven success since centuries and inexpensive nature without the need of additional equipments. However, considerable intra-operative bleeding due to severing of blood vessels and post surgical scarring are the major drawbacks with the use of scalpel.⁴

Electrosurgery (ES) is the application of a high-frequency electric current to biological tissue as a means to cut, coagulate, desiccate, or fulgurate tissue.⁸⁴ By varying the mode of application of this type of current, the clinician can use ES for cutting or coagulating soft tissues. Tissues are naturally resistant to high-frequency waveforms; when these waveforms pass through it, intense intracellular heat is produced within the tissues contacted by the active electrode tip. This heat volatilizes cells and as the electrode is guided through the tissue, it leaves a path of cell destruction in the form of an incision or surface coagulation.³

Electo-surgery offers oral surgery many unique, invaluable advantages. Hemostasis obtained with fully rectified cutting current, scar free healing of electro-surgical wounds by granulation secondary repair as well as by primary intention, the ability to perform precise tissue cutting without use of manual pressure and sterilization of the surgical fields are especially noteworthy advantages. Atraumatic tissue cleavage and sterilization of the wound eliminate unfavourable postoperative sequelae common to scalpel surgery and contribute materially to rapid, uneventful postoperative healing.⁴

In the present study, although electro-surgery could not provide complete hemostasis, the bleeding was significantly less (p < 0.001) for electro-surgery than that of scalpel surgery. We observed that the bleeding and time taken for incision were significantly less in electro-surgery as compared to scalpel surgery. The pain and healing were comparable in both the groups. The inconsistency of reports on the healing of electro-surgical wounds may be attributed to the lack of standardization of the factors involved in ES. Just as preparation of a tooth with a high-speed turbine without adequate cooling spray can devitalize the pulp, use of ES without optimal control of the relevant factors can produce adverse effects. The factors to be controlled during ES are waveform, power setting, cutting stroke and surface condition of the tissue. The thickness and shape of the active electrodes and the depth of the incision are other factors that can also affect outcome. When those factors are controlled, no clinical or significant histologic difference can be seen between the healing of electro-surgical wounds and that of scalpel wounds.

Summary & Conclusions

Electrosurgery has several applications in oral surgery, but this technique is not very widely used. The presence of conflicting and sometimes confusing information on electrosurgical wound healing in the literature is the most likely reason.³ Although some reports have focused on the negative aspects of ES,^{7,8,9} there are as many reports that have shown that there is no difference in the clinical healing of ES and scalpel wounds.^{10,11,12,13,14} Advantages of use of electro-surgery include clean tissue separation with little or no bleeding reduced Chair time and operator fatigue as well as precise and pressureless technique. The major pitfalls of electro-surgery include its contraindication near inflammable gases and greater initial cost of the ES equipment than that of a scalpel.³

Hence, it can be concluded that although electro-surgery will never completely replace the cold blade, its benefits outnumber its shortcomings especially in highly vascular areas such as the head and neck region. An ES unit costs only a small fraction of the price of

a CO2 laser unit and can be used to perform many of the soft tissue surgical procedures being carried out with lasers. If the clinical electrosurgical procedures are applied in accordance with the recommended principles, electro-surgery is certainly of great value in minor oral surgery.

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