



Keywords

Skin Incision,
Scalpel,
Electrocautery

Received: April 4, 2015

Revised: April 15, 2015

Accepted: April 16, 2015

Safety and efficacy of electrocautery in comparison to scalpel in forearm skin incision during fixation of fracture of forearm bone with plate and screws

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Citation

Shah Kalawar R. P., Khanal G. P., Chaudhary P., Rijal R., Maharjan R., Paneru S. R., Pokharel B.. Comparative Study of Safety and Efficacy of Electrocautery Blade with Cold Scalpel Blade for Skin Opening During Fixation of Fracture of Forearm Bone with Plate and Screws.

International Journal of Chemical and Biomedical Science. Vol. 1, No. 2, 2015, pp. 52-55.

Abstract

Background: Skin incisions have usually been made using a scalpel. Electrocautery, a more recent alternative, is thought to increase the risk of infection, impair healing and decrease cosmesis. Recent studies suggest that electrocautery may offer potential advantages with respect to blood loss, incision time and postoperative pain. **Aim:** The aim of this study was to compare the efficacy and safety of electrocautery incisions versus conventional scalpel incisions in orthopedic surgeries using internal implants. **Methods:** The study was conducted as a prospective study in a tertiary care center in the Department of Orthopaedics, BPKIHS, Dharan, Nepal. Patients with closed fracture of the forearm bones admitted for surgery from April 2014 to September 2014 was included in the study. Each incision was divided into two halves, proximal half to be opened by steel scalpel blades and the distal half to be opened by an electrocautery blade. Proximal half and distal half of incision were compared on operating day and on days 2, 14 and again on 6 weeks and 3 month. **Results:** A total of 60 patients were enrolled in the study. Forearm skin incisions using electrocautery were significantly quicker than scalpel incisions ($p < 0.05$). Postoperative wound complication rates did not differ significantly between the Scalpel and Electrocautery groups ($p > 0.05$). **Conclusion:** There is no difference in healing of two halves of skin incision made by electrocautery and scalpel in orthopedic surgeries using internal implants.

1. Introduction

The art of performing surgeries have improved in recent years with the development of various electrosurgical devices assisting surgeons in performing safer surgeries with better outcomes. Skin incision has traditionally been made with a standard scalpel blade with good primary healing. The electrocautery has been used safely in performing deeper dissections. Use of electrocautery in skin incision has been discouraged in the past for the fear of cutaneous scarring, wound dehiscence, and infections particularly in orthopedic surgeries using internal implants.

1.1. Review of Literature

Kearns SR, Connolly EM, McNally S, McNamara DA, Deasy J. (1988) had performed “Randomized clinical trial of diathermy versus scalpel incision in elective midline laparotomy. They concluded electrosurgical midline incision in elective surgery has significant advantages over scalpel use in terms of incision time, blood loss and early postoperative pain and analgesia requirements [1].

In a study “Safety and efficacy of electrocautery scalpel utilization for skin opening in neurosurgery” by B. SHEIKH (2004), It has been concluded that the micro-needle electrocautery scalpel is both safe and useful in neurosurgical procedures. The findings of this study support the use of the micro-needle electrocautery scalpel in all neurosurgical procedures, especially when blood loss is of a significant issue such as in paediatric cases [2].

Chrysos E, Athanasakis E, Antonakakis S, Xynos E, Zoras O (2005) had conducted “A prospective study comparing diathermy and scalpel incisions in tension-free inguinal hernioplasty”. Their result showed the use of diathermy for skin incision during inguinal hernioplasty is as safe as the use of scalpel in terms of wound healing. The use of diathermy reduces the analgesics requirements in the postoperative period [3].

Byrne FJ et al. (2007) have demonstrated a clear advantage in the use of diathermy to create a hip incision showing a significant reduction in wound-related blood loss and a reduction, whilst not statistically significant, in total operative blood loss in his study titled “Diathermy versus scalpel incisions for hemiarthroplasty for hip fracture: a randomized prospective trial” [4].

Muhammad Shamim (2009) has concluded in his study titled “General Surgery: Double-Blind, Randomized, Clinical Trial” that diathermy incision has significant advantages compared with the scalpel because of reduced incision time, less blood loss, & reduced early postoperative pain [5].

PL Chalya, MD Mchembe, JB Mabula, JM Gilyoma (2013) have concluded that diathermy incision in elective midline laparotomy has significant advantages compared with that of the scalpel because of reduced incision time, less blood loss, reduced early postoperative pain and analgesic requirements. Their study was Diathermy versus Scalpel incision in elective midline laparotomy: A prospective randomized controlled clinical trial [6].

1.2. Rationale of the Study

A review of the literature shows not many studies have been conducted to evaluate the safety and efficacy of electrocautery in skin incisions during orthopedic surgeries using internal implants.

1.3. Objective

To determine whether an electrocautery blade can be used

safely for skin incisions in limb surgeries.

2. Research Design and Methodology

The study was conducted as a prospective study in a tertiary care center in the Department of Orthopaedics, BPKIHS, Dharan, Nepal. Patients with closed fracture of the forearm bones admitted for surgery from April 2014 to September 2014 was included into the study. Ethical clearance was obtained before the study from Institute Ethical Review Board and informed consent was taken from each patient involved in the study.

The following patients were excluded from the study:

- Open fractures,
- Previous history of hypertrophic or keloid scarring,
- Patients suffering from chronic immunosuppressive disorders or wound healing problems,
- Patients on long-term medications, which interferes with wound healing, such as corticosteroids, anticancer drugs, or colchicines for gout.

The patients were given numerical codes in sequence. All surgeries were performed under general/regional anesthesia with use of tourniquets. The incision site was marked. Each incision was then divided into two halves, proximal half to be opened by steel scalpel blades and the distal half to be opened by an electrocautery blade [figure 1a]. The electrocautery unit was set on cutting pure mode, at a power of 5 W and using a 390-kHz sinusoid waveform during the procedure.

The incision depth included the epidermis, dermis, and the superficial part of the subcutaneous layer. During electrocautery incision, only the tip of the blade was allowed to come in contact with the proposed incision line and care was taken not to touch the skin edges with the sides of the electrocautery blade at any time by applying mild traction on either sides of the skin incision as the cutting proceeded.

The floor nurse noted the time taken to complete the incision on each side separately using a stop clock. The length of each half of the incision was recorded. The speed of skin incision was calculated in mm/s from the start of incision until completion of the incision, including hemostasis. The speed of incision was calculated by dividing length in millimeters by time in seconds for each half separately. The time calculated for incision did not include deep fascia or periosteum opening.

On completing total skin incision, the wound edges were inspected for any physical differences between the parts performed by the electrocautery and cold scalpel [figure 1b]. The incision wound with scalpel and electrocautery was inspected in each case immediately after completing the skin incision with respect to color, viability, presence of charring effect, and dermal peeling by naked eye examination.

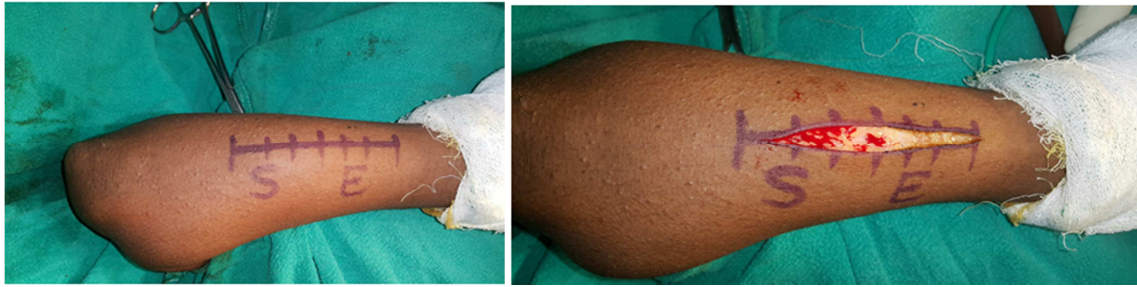


Figure 1a. Skin incision marked and divided into proximal half to be opened by scalpel (S) and distal half to be opened by Electrocautery; **1b:** Macroscopic appearance of the wound on completing skin incision

Deeper dissection was continued as usual and fractures was fixed with a 3.5 mm low-contact dynamic compression plate in each case. The wound was closed in layers using nylon or staples for the skin. The fascia was not closed to decrease the chance of compartment syndrome if any. The wound was inspected on postoperative days 2, 14 and at 6-weeks post-operative follow-up.

The variables evaluated in this study was time taken for incision; differences with respect to physical inspection of the wound edges soon after incision; cosmetic appearance of the scar as good, poor, contracted; and formation of keloids and wound complications.

3. Results

Sixty incisions were performed using a cold scalpel and electrocautery blade in open reduction and internal fixation of the fracture of the shaft of the radius and/or ulna using a low-contact dynamic compression plate.

The speed of incision with a cold scalpel was between 0.65 mm/s and 2.1 mm/s, with an average of 1.0 mm/s. The speed of incision with electrocautery blade was between 1.2 mm/s and 2.9 mm/s, with an average of 1.8 mm/s. The average time taken by electrocautery for performing a 10 cm skin incision was 1 min while it was 2 min by cold scalpel. The time taken for incision with electrocautery was much lower in comparison with the cold scalpel.

There were no macroscopic differences with respect to color, viability, presence of charring effect, and dermal peeling between cold scalpel and electrocautery incisions. Postoperative inspection on days 2 and 14 also did not have any differences in the physical character of the wound [Figure 2a].

Healing of skin wound incised with cold scalpel and electrocautery at the end of 6 weeks and 3 months were the same [Figure 2b]. There were no differences in scar tenderness on either half of the incision made by cold scalpel and electrocautery at 3 months follow up.



Figure 2a. Macroscopic appearance of the wound on 2nd week follow up and **2b:** on 6 month follow up.

Because of the tourniquet application, blood loss with these two methods of incision could not be evaluated.

Two (3.3%) cases of superficial stitch abscess were found involving the full length of the skin incision, which was effectively managed with antibiotics and regular dressings.

There was no evidence of scar tenderness, hypertrophy, or keloid formation of the scar, or wound dehiscence either with cold scalpel or electrocautery incision in 3 month follow up.

4. Discussion

Surgical electrocautery has increasingly been used for tissue dissection, being haemostatic and convenient, since beginning of its introduction in 20th century [7-9]. Surgeons, however, continue to be reluctant when it comes to the use of electrocautery for making an incision of skin [9, 10, 11]

because previous studies has shown that the use of electrocautery causes devitalization of tissue within the wound which consequently lead to wound infection, delayed wound healing and excessive scarring [9, 10, 12, 13]. Despite this evidence in these randomized clinical trials in support of electrocautery use in making skin incisions, many surgeons in many centers including our centre still are reluctant to use electrocautery in making skin incisions [10, 11]. So this study was aimed at investigating this alternative method of incision with comparison to the scalpel incision with regards to advantages, like time and bleeding, as well as alleged complication like wound infection.

There are conflicting results in human studies. It has been reported in Soballe et al [14] study that electric coagulation increases the incidence of indurated margins, infections, and weakness of the surgical wound in comparison to that of

knife. Conversely, Groot et al [15] reported that use of surgical electrocautery to create surgical wounds in patients undergoing abdominal or thoracic operations carries a wound infection rate similar to that of scalpel.

Our present study shows electrocautery incision is better than scalpel incision in terms of time taken for incision, and no significant difference in terms of wound healing, post operative complication rate and in length of hospital stay in open reduction and internal fixation of the fracture of the shaft of the radius and/or ulna using a low-contact dynamic compression plate. Blood loss could not be compared due to use of tourniquet.

The fear of tissue injury and wound complication in electrocautery incision was unfolded when this technique was used by Peterson [16] in reconstructive and cosmetic faciomaxillary surgery, Tobin [17] in blepharoplasty, with minimum scarring and excellent results.

Kearns et al [12] who compared electrosurgical and scalpel methods in hundred patients undergoing elective midline incision have found that the diathermy incision has significant advantages over scalpel incision based on incision time, blood loss, early postoperative pain and analgesia requirements. There was no significant difference in terms of wound complications, including wound infection, which resembles with the findings of this study. The present study showed no statistically significant differences in the rate of postoperative complications and postoperative hospital stay which is in consistent with other trials [9, 12]. On the basis of this study, it is suggested that skin may be safely incised using electrocautery in limb surgery involving fixation of bones using internal implants.

5. Conclusion

We conclude that skin may be safely and rapidly incised using electrocautery in limb surgery involving fixation of bones using internal implants with as good wound healing characteristics as that of with cold scalpel.

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