

# Diathermy versus Scalpel Skin Incision for Open Inguinal Hernia Surgery: An Interventional Study

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## ABSTRACT

**Introduction:** Inguinal hernia is one of the most encountered surgical-related problems worldwide. For years, there has been debate among surgeons about which type of skin incision to use: cutting with electrocautery or the traditional method of a surgical scalpel.

**Aim:** To compare the skin incisions made with electrocautery versus traditional scalpel incisions in terms of incision time, blood loss, postoperative pain, and scar evaluation.

**Materials and Methods:** A hospital-based prospective interventional study was conducted at the Department of General Surgery, Sri Manakula Vinayagar Medical College and Hospital, Puducherry, India, from November 2019 to September 2021. Written informed consent was obtained from 130 consecutive cases scheduled for open inguinal hernia surgery. Patients were alternately assigned to undergo incision with electrocautery (group A) or a conventional steel scalpel (group B), with each group comprising 65 patients. Bilateral hernia cases were treated as separate entities. Data analysis was performed using Microsoft Excel and Statistical Package for Social Sciences (SPSS) software version 24.0, employing

the Student's t-test and Chi-square test. A p-value of <0.05 was considered statistically significant.

**Results:** The age distribution in group A was  $49.69 \pm 15.74$  years and in Group B was  $52.81 \pm 14.25$  years. The time taken for incision in the electrocautery group was much shorter at  $12.57 \pm 11.55$  seconds than in the scalpel group at  $20.63 \pm 2.99$  seconds, with a p-value of <0.001. The average amount of blood loss in group A was  $1.02 \pm 0.35$  mL and in group B was  $2.03 \pm 0.32$  mL, with a significant p-value of <0.001. The postoperative pain, calculated by the Visual Analogue Scale (VAS), showed a significant difference in the early postoperative period at 6 hours after surgery in Group A at  $6.58 \pm 0.9$  compared to group B at  $7.05 \pm 1$ , with a p-value of 0.005. However, no significant difference was noted between the two groups at 12, 24, and 48 hours after surgery. There was no significant difference in scar evaluation between group A and group B at 12 weeks, with a p-value of 0.673 for the patient score and 0.189 for the observer score.

**Conclusion:** Electrocautery can be recommended for hernia skin incision due to its advantage of shorter incision time, minimal blood loss, and less early postoperative pain.

**Keywords:** Blood loss, Observer score, Postoperative pain, Visual analogue score

## INTRODUCTION

Inguinal hernia repair, one of the most routinely performed surgeries globally, exceeds 20 million procedures annually [1]. In India, studies estimate the national prevalence of inguinal hernia to be between 1.5 to 2 million cases, with a higher incidence in men compared to women [2]. Surgical skin incisions can be made with a scalpel or electrocautery. While scalpel incisions involve the use of a sharp blade, diathermy employs heat for tissue incision, potentially offering benefits such as reduced haemorrhage and rapid tissue separation [3].

A systematic review and meta-analysis found that there is no significant difference between the use of diathermy and a scalpel for skin incision in terms of surgical site infection, seroma, and postoperative pain [4]. Another prospective study supported the safety of using diathermy for skin incisions during inguinal hernioplasty, finding it as safe as a scalpel in terms of wound healing and reducing the need for analgesics [5]. Therefore, based on the available evidence, the choice between diathermy and a scalpel for creating skin incisions in open inguinal hernia repair may depend on surgeon preference, as both methods have been shown to be safe and effective.

The scalpel was considered the gold standard for making skin incisions until the invention of diathermy. The scalpel precludes the possibility of burn injuries and hence reduces the chances of excessive scarring and poor wound healing. However, due to the increased seroconversion rate in healthcare workers due to the handling of sharp instruments, a sharpless alternative for making

skin incisions was developed. Studies conducted by Talpur et al., and Allan et al., highlighted the significant risks associated with surgical scalpel use, including an 8% tissue damage rate and the transmission of blood-borne infections among surgeons [6,7].

Despite its potential advantages in various surgical procedures, the use of electrocautery for skin incisions is still limited due to concerns about burn-related wound complications and inadvertent damage to deeper structures [8,9]. While existing research, including a systematic review and meta-analysis, suggests that diathermy incisions are associated with decreased blood loss and quicker incision times compared to scalpel incisions [10], further exploration is needed across diverse general surgical cases. Our study aimed to bridge this gap by conducting a comprehensive analysis of electrocautery skin incisions, comparing them to traditional scalpel incisions and considering factors such as incision time, blood loss, postoperative pain, and scar evaluation.

## MATERIALS AND METHODS

A hospital-based prospective interventional study was conducted at the Department of General Surgery, Sri Manakula Vinayagar Medical College and Hospital, Puducherry, India from November 2019 to September 2021. The study received approval from the Institutional Ethics Committee (ECR/1088/2013).

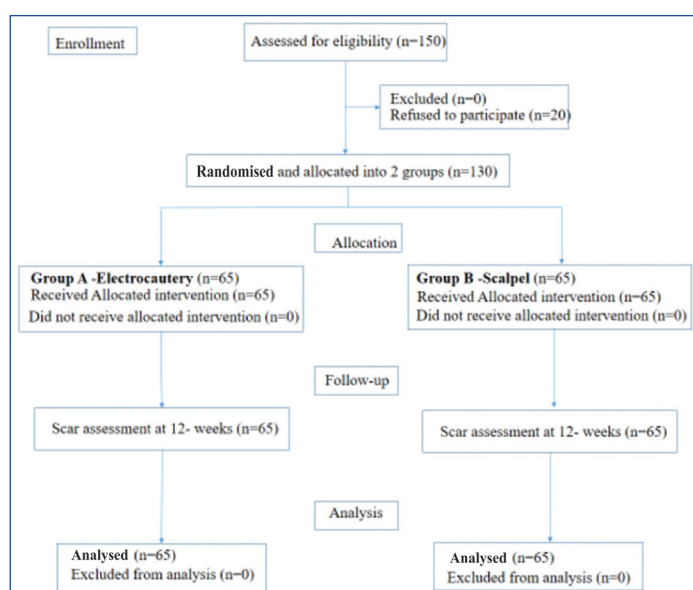
**Inclusion and Exclusion criteria:** Patients scheduled for open inguinal hernia surgery and willing to participate were included in the study. Patients below 18 years and above 85 years, patients

undergoing emergency surgeries, patients with contraindications to the use of diathermy, patients with previous abdominal surgical scars, and reoperation cases were excluded.

**Sample size calculation:** The initial sample size calculated was 150 with a 95% confidence interval using the formula  $4PQ/n^2$  and considering a prevalence of 15% wound infection rates reported in a study, where the investigation revealed a prevalence of 17.5% for scalpel incisions and 12.5% for diathermy incisions, and a relative precision of 5%, subsequently adjusted to 130 due to the impact of the Coronavirus Disease-2019 (COVID-19) pandemic and restrictions on elective cases [11].

## Procedure

A total of 130 consecutive cases scheduled for open inguinal hernia surgery were enrolled, with patients alternately allocated into group A (cutting electrocautery) or group B (conventional steel scalpel). Each group consisted of 65 patients, and bilateral hernia cases were treated as two separate cases, allowing for a comprehensive comparison of scalpel and diathermy incisions in the study [Table/Fig-1].



[Table/Fig-1]: Consolidated Standards of Reporting Trial (CONSORT) flow diagram.

The time taken for skin incision was noted using a standard electronic stopwatch with milliseconds, separately for diathermy and scalpel incisions. Incision length and any extensions were recorded using an inch tape, while blood loss was calculated using preweighed swabs. Postoperative pain was recorded up to 48 hours using the VAS at 6, 12, 24, and 48 hours [12]. Postoperative analgesia details were also recorded.

Wound complications were treated with appropriate antibiotics, cleaning, and dressing. Patients with co-morbidities like diabetes mellitus, systemic hypertension, Coronary Artery Disease (CAD), or Chronic Kidney Disease (CKD) were documented, and their relation to wound healing, complications, or scar formation was noted. Scar assessment at the 12-week follow-up utilised the patient and observer scar assessment scale [12], with both patient and observer scores recorded and averaged.

## STATISTICAL ANALYSIS

Data was entered into EpiInfo version 7.2 and analysed using SPSS Version 24.0. Statistical analysis used the unpaired t test, Chi-square test, and Fisher's-exact test. A p-value of <0.05 was considered statistically significant.

## RESULTS

A total of 130 cases were included, with 96 being unilateral and 17 being bilateral cases [Table/Fig-2].

Study participants		Number (n)
Total patients enrolled		113
Total cases enrolled		130
Inguinal hernia distribution	Unilateral cases	96
	Bilateral cases	17

[Table/Fig-2]: Distribution of study participants (N=130).

The age distribution shows comparable distribution between group A (49.69±15.74 years) and Group B (52.81±14.25 years), with no significant difference (p-value=0.235) [Table/Fig-3].

Variables	Group A	Group B	p-value*
Age (Mean±SD)	49.69±15.74	52.81±14.25	0.235
Sex			
Male	55 (97%)	55 (97%)	1.000#
Female	1 (3%)	2 (3%)	
Left hemioplasty	25 (39.4%)	26 (40.9%)	1.000
Right hemioplasty	40 (60.6%)	39 (59.1%)	

[Table/Fig-3]: Demographic profile and case distribution in open inguinal hernia repair (N=130).

\*Chi-square test; #Fisher-exact test

There was no statistically significant difference in incision length between the two groups (5.77±0.91 cm in Group A and 5.74±0.79 cm in group B), with a p-value of 0.838. However, significant differences were observed in the time taken for incision and blood loss between the groups [Table/Fig-4].

Variables	Group A	Group B	p-value
Time taken for incision (sec)	12.57±11.55	20.63±2.99	<0.001**
Length of incision (cm)	5.77±0.91	5.74±0.79	0.838
Blood loss (mL/cm)	1.02±0.35	2.03±0.32	<0.001**

[Table/Fig-4]: Perioperative parameters in open inguinal hernia repair.

\*\*p<0.001; Significant; Student's t-test was used

Postoperative pain levels were assessed by the VAS at various time intervals (6, 12, 24, and 48 hours) following the surgical procedure. Due to the challenge of localising pain in patients who underwent bilateral procedures, all bilateral cases were excluded from both postoperative pain assessment and analgesic requirements. The analysis of postoperative pain assessment and analgesic requirements was specifically conducted on 96 unilateral cases. A significant reduction in postoperative pain within the electrocautery group during the early postoperative phase, particularly at 6 hours after surgery, was observed [Table/Fig-5].

Postop pain assessment (VAS)	Group A	Group B	p-value*
6 hours	6.58±0.9	7.05±1	0.005**
12 hours	5.06±0.93	5.35±0.9	0.073
24 hours	3.62±0.94	3.92±0.9	0.061
48 hours	1.74±0.62	1.91±0.6	0.118
Total analgesia (ln mg)	227.27±58.29	236.36±64.77	0.398

[Table/Fig-5]: Postoperative pain scores and analgesic requirements in open inguinal hernia repair (n=96).

\*Student's t-test

Analgesics used postoperatively were Inj. Tramadol 50 mg IM or Tab. Tramadol 50 mg, with dose adjustments based on the pain scale. No statistically significant differences in dose requirements were observed between the two groups.

The scar assessment at the 12<sup>th</sup> week postoperatively revealed no significant difference between the two groups. However, a notable distinction was observed between the patient score and the observer score, with a p-value of <0.001, indicating a significant difference in their assessments within the groups [Table/Fig-6].

Variables	Group A	Group B	p-value*
Patient score	20.61±5.31	20.24±4.53	0.673
Observer score	16.11±5.07	17.2±4.41	0.189
Difference	4.53	3.05	-
p-value	<0.001**	<0.001**	-

**[Table/Fig-6]:** Comparison of patient and observer scores between the two groups ((Patient and Observer Scar Assessment Scale (POSAS)) score) at 3<sup>rd</sup> month for scar assessment.

\*Fisher-exact test

## DISCUSSION

There is still a debate regarding the application of electrocautery for the initial skin incision, even though it has been shown to be safe and effective for dissecting subcutaneous tissue and muscle layers. Recent diathermy studies present promising outcomes, indicating faster operating times, reduced blood loss, lower postoperative pain, and diminished analgesic requirements compared to scalpel incisions [2,3,6]. Few studies have raised concerns about wound healing and have shown more wound infections in the electrocautery group [7-9,13,14].

The concern regarding tissue injury associated with electrocautery can be traced back to the groundbreaking work of Peterson A in faciomaxillary surgery [15], Mann W and Klippel CH in paediatric surgery [16], Kamer FM and Cohen A in rhytidoplasty [17], and Tobin HA in blepharoplasty [18]. These pioneers demonstrated that electrocautery usage resulted in minimal scarring and yielded excellent surgical outcomes. Subsequently, skin incisions in general surgery were reported by Dixon AR and Watkin DF in patients undergoing inguinal herniorrhaphy and cholecystectomy [19].

In our study, the electrocautery group had a significantly shorter incision duration of 12.57±11.55 seconds with a p-value of <0.001 compared to the scalpel group. This study was in concordance with the findings of many other studies [4,20,21]. Contrary to our study, Charoenkwan K et al., showed no significant difference in incision time between electro surgery and scalpel (MD-45.74 seconds, 95% CI-88.41 to -3.07) where 325 participants underwent different abdominal surgeries including hernioplasty [22].

In the present study, the electrocautery group had minimal blood loss of 1.02±0.35 mL with a p-value of <0.001 compared with the scalpel group. This was comparable to studies conducted by Shamim M, Imran M et al., and Agarwal PK [3,21,23]. However, this finding was contrary to the literature study conducted by Charoenkwan K et al., where 241 participants underwent different abdominal surgeries including hernioplasty, and it showed no significant difference in mean blood loss between electro surgery and scalpel (MD-20.10 mL, 95% CI-28.16 to -12.05) [22]. In a study conducted by Chrysos E et al., in patients undergoing hernioplasty, he noted that the blood loss between the two groups was not statistically significant [5]. This difference in blood loss is attributed to the coagulation effect of electrocautery, which seals blood vessels as it cuts, reducing bleeding during and after the procedure. Additionally, electrocautery has been shown to result in quicker incisional and operative times.

Postoperative pain was comparable in both groups except in the early postoperative period of six hours after surgery, which was significantly less in the electrocautery incision in the present study. Contrary to the present study findings noted by Imran M et al., where the mean VAS score was significantly less in the diathermy group at 6, 12, and 24 hours after surgery with a p-value of <0.01 [21]. The present study findings were also contrary to the findings of Shamim M, where pain perception was found to be markedly reduced during the first 48 hours after surgery [3].

In a study conducted by Bhadauria NS et al., comparing the electrocautery group with the scalpel group to assess scar outcomes, the electrocautery group showed better results compared

to the scalpel group [24]. In their study, the cosmetic outcome was calculated using the Manchester scar score, which was higher in the scalpel group (group B) at 8.5 than in the electrocautery group (Group A) at 7.04 on the 7<sup>th</sup> postoperative day, group B at 10.2, group A at 8.6 at one month, and Group B at 10.6, group A at 8.8 at three months, favouring the electrocautery group. The present study showed that the scar assessment done at the 12<sup>th</sup> week showed no difference between the two groups, which was comparable with the study findings noted by Ragesh KV et al., [25]. Proper usage with correct frequency adjustment and following specific instructions mentioned by the electrocautery manufacturer will definitely yield better results than scalpel skin incision.

## Limitation(s)

Due to COVID-19 restrictions, the study's sample size was reduced to 130, potentially impacting generalisability. Scar assessment lacked consideration for grading planning, and standardising anaesthesia was challenging, particularly in bilateral cases with combined epidural and spinal anaesthesia.

## CONCLUSION(S)

The electrocautery group showed reduced intraoperative blood loss and shorter incision times compared to the scalpel group. Considering these findings, the conclusion drawn was that electrocautery emerges as a safe and effective alternative to the traditional scalpel for making skin incisions in open inguinal hernia surgery.

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