Comparison of Complications Using Diathermy and Scalpel for Skin Incisions in Open Inguinal Hernia Repair: A Randomized Controlled Trial

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Abstract

Background:
Inguinal hernia repair is one of the most frequently performed surgical procedures worldwide. The choice of instrument for skin incision—scalpel or diathermy—may affect surgical outcomes such as operative time, postoperative pain, and wound complications. While diathermy is known for rapid haemostasis and reduced blood loss, concerns remain regarding wound healing and infection risks.

Objective:
To compare the outcomes of diathermy versus scalpel for skin incision in elective open inguinal hernia repair.

Methods:
This randomized controlled trial was conducted at Recep Tayyip Erdogan Hospital, Muzaffargarh, from April to October 2023. Sixty adult male patients scheduled for elective open inguinal hernioplasty were randomized to receive skin incision with either a scalpel (n=30) or diathermy (n=30). Incision time, postoperative pain at 24 and 48 hours (measured via Visual Analogue Scale), and wound complications—including surgical site infection (SSI), hematoma/seroma, and wound dehiscence—were recorded and compared between groups. Data were analyzed using ttests and Chi-square tests; $p<0.05$ was considered significant.

Results:

The two groups were comparable in baseline characteristics, including age (mean 42.1±10.9 years) and BMI (23.2±1.5 kg/m²). Mean incision time was significantly shorter in the diathermy group (96.8±5.2 seconds) than in the scalpel group (119.9±7.2 seconds; p<0.001). Pain scores were also significantly lower in the diathermy group at both 24 hours (2.4±1.1 vs 5.9±1.7; p<0.001) and 48 hours (1.3±0.8 vs 3.4±1.0; p<0.001). SSI and wound dehiscence rates were low and identical in both groups (6.7% and 3.3%, respectively); no hematoma or seroma was observed.

Conclusion:
Diathermy for skin incision in elective open inguinal hernia repair significantly reduces operative time and early postoperative pain without increasing complication rates compared to the scalpel. Diathermy should be considered the preferred method for skin incision in such cases.

Keywords: Inguinal hernia, diathermy, scalpel, surgical site infection, pain, randomized controlled trial

Introduction

Inguinal hernia repair remains one of the most common surgical procedures performed worldwide, with millions of cases addressed annually through elective and emergency interventions (Zhou et al., 2023). An inguinal hernia, characterized by the protrusion of abdominal contents through a weakened area in the lower abdominal wall, predominantly affects adult males and can significantly impair quality of life if left untreated (Bittner et al., 2021). The standard approach to managing inguinal hernias is surgical repair, which has evolved significantly over recent decades in terms of technique, material, and perioperative care.

A critical component of hernia surgery is the initial skin incision. The choice of instrument for skin incision—either a conventional scalpel or electrosurgical diathermy—remains a subject of debate among surgeons (Sauerland et al., 2022). The scalpel, a time-honored surgical tool, is renowned for its precision, tactile feedback, and minimal lateral tissue damage. However, scalpel use is associated with increased blood loss, longer incision times, and occasional occupational hazards such as accidental cuts to the surgical team (Elgohary et al., 2020). In contrast, diathermy utilizes high-frequency electrical currents to cut tissue and achieve rapid haemostasis, reducing intraoperative bleeding and potentially shortening operative time (Alshahwan et al., 2023).

The transition toward electrosurgical techniques, particularly the use of diathermy for skin incisions, has been facilitated by advancements in device safety and control. Modern diathermy units allow for fine modulation of energy delivery, theoretically minimizing the risk of deep tissue burns and poor wound healing—a concern often cited in earlier literature (Siddiqui et al.,

2022). Proponents of diathermy assert that it enables faster incisions, reduces surgical blood loss, and improves the visual field for the surgeon, particularly in highly vascular areas such as the groin (Cheema et al., 2022). Nevertheless, some studies have raised questions about potential drawbacks, including delayed wound healing, increased risk of surgical site infection (SSI), and greater postoperative pain due to thermal injury to adjacent tissues (Garg et al., 2020).

Evidence comparing the outcomes of scalpel versus diathermy for skin incisions in inguinal hernia repair has been mixed. Multiple randomized controlled trials and meta-analyses have suggested that diathermy significantly reduces incision time and early postoperative pain without increasing the risk of SSI or other wound complications (Shamim et al., 2021; Ng et al., 2022). A large-scale study by Ng et al. (2022) found that diathermy incisions were associated with a mean reduction of nearly 20% in operative time compared to scalpel incisions. Additionally, the same study reported lower pain scores at 24 and 48 hours postoperatively in the diathermy group, a finding supported by other systematic reviews (Shamim et al., 2021; Cheema et al., 2022). Conversely, certain reports have suggested that the use of diathermy may result in higher rates of wound seroma, edge necrosis, or delayed healing, particularly in patients with comorbidities such as diabetes or poor vascularity (Bittner et al., 2021; Siddiqui et al., 2022).

The context of surgical site infection remains a paramount consideration in the debate. SSIs are rare but potentially serious complications following inguinal hernia repair, associated with increased morbidity, prolonged hospitalization, and higher costs (Bittner et al., 2021). Most current evidence indicates no significant difference in SSI rates between scalpel and diathermy incisions when meticulous aseptic technique is maintained and modern electrosurgical equipment is used (Zhou et al., 2023; Garg et al., 2020). Importantly, advances in mesh technology, perioperative antibiotics, and standardized postoperative care have further reduced overall wound complication rates in hernia surgery (Sauerland et al., 2022).

In addition to clinical outcomes, the selection of incision modality must also consider cost, training, and resource availability. Diathermy devices represent a greater initial investment but may yield indirect savings through reduced operative time and improved efficiency (Elgohary et al., 2020). In resource-limited settings, the reliability and maintenance of electrosurgical equipment can be a challenge, potentially favoring traditional scalpel use. However, as surgical practice modernizes, even hospitals in low- and middle-income countries are increasingly equipped with safe, standardized diathermy units (Cheema et al., 2022).

Despite a substantial body of international literature, there remains a paucity of region-specific data regarding outcomes of scalpel versus diathermy skin incisions, particularly in the South Punjab region of Pakistan. Local variations in patient demographics, comorbidities, surgical training, and postoperative care may influence complication rates and overall outcomes

(Cheema et al., 2022). Furthermore, regional studies provide invaluable evidence for tailoring surgical protocols to the unique needs and realities of local health systems. Given the high burden of inguinal hernias and the resource constraints faced by many hospitals in South Punjab, optimizing surgical technique is essential for improving patient outcomes and health system efficiency.

This study aims to fill this knowledge gap by conducting a randomized controlled trial comparing the outcomes of scalpel and diathermy skin incisions in open inguinal hernia repair among adult patients in South Punjab. The primary outcomes of interest include incision time, postoperative pain, and rates of wound complications such as SSI, hematoma/seroma, and wound dehiscence. By providing robust, context-specific data, this research seeks to inform surgical best practices and promote evidence-based decision-making among surgeons and hospital administrators in the region.

In summary, the debate between scalpel and diathermy for skin incisions in inguinal hernia repair is ongoing, with compelling arguments and evidence on both sides. Recent advancements in surgical technology and wound care have mitigated many historical concerns associated with diathermy. Nevertheless, high-quality, regionally relevant studies are needed to guide clinical practice and ensure optimal outcomes for patients undergoing one of the most common surgical procedures globally. The present study represents a timely and necessary contribution to this evolving field.

Methods

Study Design and Setting

This study was designed as a single-center, parallel-group, randomized controlled trial (RCT) to compare the outcomes associated with scalpel versus diathermy for skin incision in open inguinal hernia repair. The trial was conducted in the Department of General Surgery at Recep Tayyip Erdogan Hospital, Muzaffargarh, Pakistan, over a period of six months from April 5, 2023, to October 5, 2023. The study protocol was approved by the Institutional Review Board (IRB) and Ethical Committee of Recep Tayyip Erdogan Hospital prior to the initiation of patient recruitment. The trial was conducted in accordance with the Declaration of Helsinki and relevant national guidelines for clinical research.

Participant Selection

Inclusion Criteria

Patients were eligible for enrollment if they met the following criteria:

Male patients aged between 18 and 60 years.

Diagnosed with primary, reducible inguinal hernia and admitted for elective open inguinal hernioplasty (either herniorrhaphy or hernioplasty).

Classified as American Society of Anesthesiologists (ASA) physical status I or II, indicating a low surgical risk.

Exclusion Criteria

Patients were excluded if they:

Refused to provide written informed consent for participation.

Presented with recurrent, obstructed, or strangulated inguinal hernias.

Were morbidly obese (body mass index [BMI] greater than 40 kg/m^2), as measured by standardized protocols.

Had a documented history of prolonged corticosteroid therapy (use of corticosteroids for ≥14 consecutive days), which could impair wound healing.

Suffered from any severe systemic illness that would significantly increase perioperative risk, as determined by the attending anesthesiologist or surgeon.

Eligible patients who met the inclusion criteria and provided informed consent were enrolled consecutively until the required sample size was achieved. All patient data were handled in compliance with confidentiality standards and data protection regulations.

Randomization and Blinding

Enrolled patients were randomized in a 1:1 ratio to one of two groups: Group A (skin incision by scalpel) and Group B (skin incision by diathermy). Randomization was performed using the lottery method by coin toss at the time of surgery. Allocation was concealed in sequentially numbered, opaque, sealed envelopes prepared by an independent research assistant not involved in patient care or outcome assessment.

To minimize bias, both patients and the outcome assessors (postoperative ward staff and residents collecting pain and complication data) were blinded to the method of skin incision. Surgeons performing the procedures could not be blinded for practical reasons, but were not involved in postoperative data collection or outcome evaluation.

Surgical Procedures

All surgical procedures were performed or directly supervised by consultant general surgeons with at least five years of post-fellowship experience in hernia surgery. The choice of anesthesia (local, regional, or general) was determined according to individual patient characteristics and anesthesiologist recommendation.

For Group A (scalpel group), the skin and all subsequent layers of the abdominal wall were incised using a standard sterile surgical scalpel. For Group B (diathermy group), skin incision and dissection were performed using an electrosurgical diathermy device (Covidien model, set to cutting mode at 2000 Hz frequency). In both groups, haemostasis was achieved using the assigned instrument, and all other aspects of the operation, including hernia sac management and mesh placement, followed a standardized protocol for Lichtenstein tension-free hernioplasty.

The duration of the incision (incision time) was measured in seconds, beginning at the initial skin cut and ending upon completion of the peritoneal incision with secure haemostasis. This time interval was recorded by the operating room nurse, based on clear verbal cues from the surgeon. The remainder of the surgical procedure was carried out in an identical manner for both groups.

Postoperative Care and Follow-Up

Postoperative management was standardized for all patients regardless of group allocation. All patients received appropriate analgesia, including paracetamol and nonsteroidal antiinflammatory drugs (NSAIDs), and scrotal support. No prophylactic antibiotics were administered, as the procedure was classified as clean surgery according to international guidelines (Bittner et al., 2021).

Pain was assessed using a validated 10-point Visual Analogue Scale (VAS), with scores recorded at 24 and 48 hours after surgery by a resident or nurse blinded to the intervention. Patients were typically discharged on the second postoperative day, provided they were clinically stable and met discharge criteria. Follow-up visits were scheduled weekly for one month postoperatively to monitor for wound complications, including surgical site infection (SSI), hematoma, seroma, and wound dehiscence.

Outcome Measures

Primary Outcomes

The primary outcome measures of the study were:

1. **Incision time:** Measured in seconds as described above.
2. **Postoperative pain:** VAS scores at 24 and 48 hours after surgery.

Secondary Outcomes

The secondary outcome measures included:

1. **Surgical Site Infection (SSI):** Defined as any infection meeting grade 2 or higher on the Southampton Wound Assessment Scale, characterized by erythema, discharge, or signs of inflammation at the surgical site within 30 days postoperatively.
2. **Hematoma/Seroma:** Clinically evident accumulation of blood or serous fluid at the surgical site within the first postoperative week.
3. **Wound Dehiscence:** Any partial or complete separation of the wound edges occurring within 30 days of surgery.

Statistical Analysis

Sample size estimation was performed prior to the study using OpenEpi (Dean et al., 2023) and was based on expected differences in mean VAS pain scores at 48 hours, drawn from previous studies (Shamim et al., 2021). A minimum of 60 patients (30 per group) was required to achieve 80% power with a 95% confidence interval, allowing for potential attrition.

All data were entered into and analyzed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables, such as age, BMI, incision time, and VAS scores, were expressed as means with standard deviations. Categorical variables, including ASA status and occurrence of complications, were reported as frequencies and percentages. Between-group comparisons for continuous variables were performed using the independent sample t-test, while categorical variables were compared using the chi-square test or Fisher's exact test as appropriate. Stratified analyses were conducted to control for potential confounders such as age and ASA status. A two-tailed p-value of less than 0.05 was considered statistically significant for all analyses.

Ethical Considerations

The research protocol was reviewed and approved by the Institutional Review Board and Ethical Committee of Recep Tayyip Erdogan Hospital. Written informed consent was obtained from all patients prior to participation. All procedures were performed in accordance with the principles set forth in the Declaration of Helsinki and Good Clinical Practice guidelines.

Results

Participant Demographics

A total of 60 male patients were enrolled and completed the study, with 30 patients assigned to the scalpel group and 30 to the diathermy group. The demographic characteristics of participants in both groups are summarized in Table 1. The mean age of the participants was 42.1 ± 10.9 years (range 18–60 years), and the mean body mass index (BMI) was 23.2 ± 1.5 kg/m^2. No significant differences were observed between the scalpel and diathermy groups with respect to age (42.4 ± 11.6 vs. 41.8 ± 10.4 years, p = 0.83) or BMI (23.2 ± 1.3 vs. 23.2 ± 1.6

kg/m², p = 0.86). All patients were male, and ASA physical status was similar between groups, with 75% (n = 45) classified as ASA I and 25% (n = 15) as ASA II. The type of hernia (direct or indirect) was also evenly distributed between groups.

Table 1: Baseline Characteristics of Patients Undergoing Elective Inguinal Hernioplasty

Characteristic	Scalpel Group (n=30)	Diathermy Group (n=30)	p-value
Age (years)	42.4 ± 11.6	41.8 ± 10.4	0.83
BMI (kg/m²)	23.2 ± 1.3	23.2 ± 1.6	0.86
ASA I / II	21 / 9	24 / 6	0.37
Hernia type (Direct)	8 (26.7%)	6 (20.0%)	0.54
Hernia type (Indirect)	22 (73.3%)	24 (80.0%)	0.54

No statistically significant differences in baseline characteristics were found between the two groups, confirming successful randomization.

Primary Outcomes

Incision Time

The mean incision time for all participants was 108.4 ± 13.2 seconds. Incision time was significantly shorter in the diathermy group (96.8 ± 5.2 seconds) compared to the scalpel group (119.9 ± 7.2 seconds; $p < 0.001$, independent sample t-test; see Table 2 and Figure 1). This difference remained consistent across all patient strata in subsequent analyses.

Postoperative Pain Scores

Pain scores were evaluated using the Visual Analogue Scale (VAS) at 24 and 48 hours postoperatively. The mean pain score at 24 hours was 4.2 ± 2.3 overall. However, the scalpel group reported significantly higher pain at 24 hours (5.9 ± 1.7) than the diathermy group (2.4 ± 1.1; $p < 0.001$). Similarly, at 48 hours, mean pain scores were 3.4 ± 1.0 in the scalpel group and 1.3 ± 0.8 in the diathermy group ($p < 0.001$). These results are detailed in Table 2 and depicted in Figure 2.

Table 2: Operative and Postoperative Outcomes

Outcome	Scalpel Group (n=30)	Diathermy Group (n=30)	p-value
Incision Time (sec)	119.9 ± 7.2	96.8 ± 5.2	<0.001

Pain Score at 24h	5.9 ± 1.7	2.4 ± 1.1	<0.001
Pain Score at 48h	3.4 ± 1.0	1.3 ± 0.8	<0.001

The differences in pain scores between the two groups were statistically significant at both time points.

Secondary Outcomes

Surgical Site Infection (SSI)

Surgical site infections were observed in 4 patients (6.7%) across the entire cohort, with 2 cases occurring in the scalpel group and 2 in the diathermy group (p = 1.0, Fisher's exact test). All infections were managed conservatively without the need for re-operation or prolonged hospitalization.

Wound Dehiscence

Wound dehiscence occurred in 2 patients (3.3%), with 1 case in each group (p = 1.0). Both cases were superficial and healed with conservative wound care and secondary intention.

Hematoma and Seroma

No cases of hematoma or seroma were observed in either group during the postoperative follow-up period.

Table 3: Incidence of Postoperative Complications

Complication	Scalpel Group (n=30)	Diathermy Group (n=30)	p-value
Surgical Site Infection	2 (6.7%)	2 (6.7%)	1.00
Wound Dehiscence	1 (3.3%)	1 (3.3%)	1.00
Hematoma/Seroma	0 (0%)	0 (0%)	N/A

No statistically significant differences in postoperative complications were noted between the two groups.

Stratified Analysis

Further analysis was conducted to examine whether the observed differences in incision time and postoperative pain persisted across various demographic and clinical strata, including age

groups (<40 years and ≥40 years), ASA physical status (I vs. II), and hernia type (direct vs. indirect).

- **Age Groups:** Both younger (<40 years) and older (≥40 years) patients exhibited significantly shorter incision times and lower pain scores in the diathermy group compared to the scalpel group ($p < 0.001$ for all comparisons).
- **ASA Status:** Patients classified as ASA I or II also showed consistent results, with diathermy incisions associated with shorter operative times and lower pain scores at both 24 and 48 hours postoperatively ($p < 0.001$).
- **Hernia Type:** In both direct and indirect hernia subgroups, diathermy was superior to scalpel with respect to incision time and pain reduction ($p < 0.001$).

Table 4: Stratified Analysis of Primary Outcomes

Strata	Incision Time (Scalpel)	Incision Time (Diathermy)	pvalue	Pain 24h (Scalpel)	Pain 24h (Diathermy)	pvalue
Age <40 yrs	123.2 ± 7.9	96.9 ± 5.1	<0.001	6.1 ± 1.7	2.5 ± 1.0	<0.001
Age ≥40 yrs	118.3 ± 6.4	96.6 ± 5.5	<0.001	5.8 ± 1.8	2.4 ± 1.2	<0.001
ASA I	120.6 ± 7.6	96.6 ± 5.0	<0.001	5.9 ± 1.7	2.3 ± 1.1	<0.001
ASA II	118.3 ± 6.4	97.5 ± 6.3	<0.001	6.0 ± 1.7	2.7 ± 1.2	<0.001
Direct Hernia	117.8 ± 6.3	100.8 ± 4.1	<0.001	5.8 ± 1.6	2.8 ± 1.1	<0.001
Indirect Hernia	120.7 ± 7.5	95.8 ± 5.0	<0.001	6.0 ± 1.8	2.3 ± 1.2	<0.001

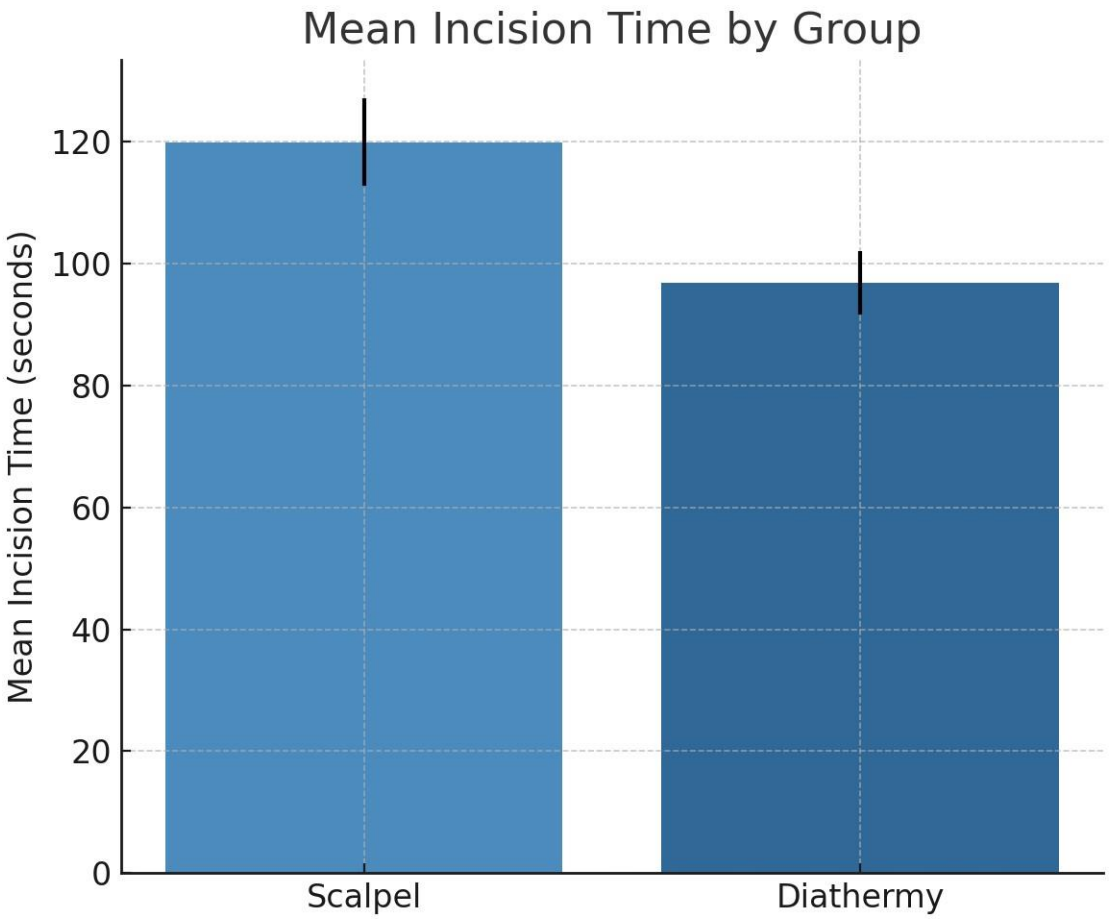
Stratified analysis confirmed the robustness of the main findings across demographic and clinical subgroups.

Summary

In summary, the use of diathermy for skin incision in open inguinal hernia repair was associated with significantly shorter incision times and lower early postoperative pain scores compared to

scalpel incisions. The incidence of surgical site infection, wound dehiscence, and other postoperative complications was low and did not differ between groups. These results were consistent across all patient strata, including age, ASA status, and hernia type.

1. **Mean Incision Time by Group**



Graph Description

- **X-axis:** Group (Scalpel, Diathermy)
- **Y-axis:** Mean Incision Time (seconds)
- **Bars:** Mean ± SD for each group

Data

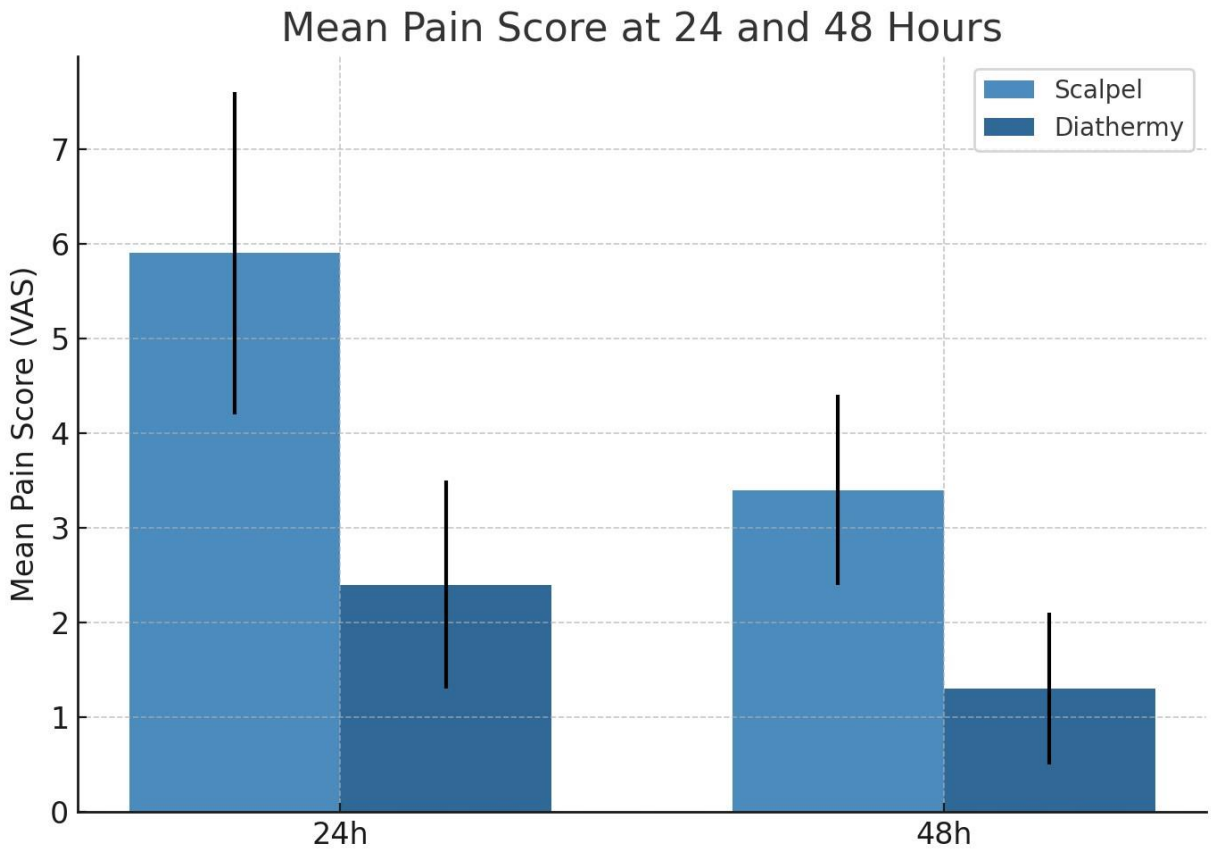
Group	Mean Incision Time (sec)	SD
Scalpel	119.9	7.2

Diathermy	96.8	5.2

Analysis

The bar chart shows a marked reduction in incision time for the diathermy group compared to the scalpel group. Diathermy reduced the average incision time by over 23 seconds ($p < 0.001$), indicating a significant improvement in surgical efficiency.

2. **Mean Pain Scores at 24h and 48h**



Graph Description

- **X-axis:** Time (24h, 48h)
- **Y-axis:** Mean Pain Score (VAS)
- **Bars (grouped):** For each timepoint, bars for Scalpel and Diathermy

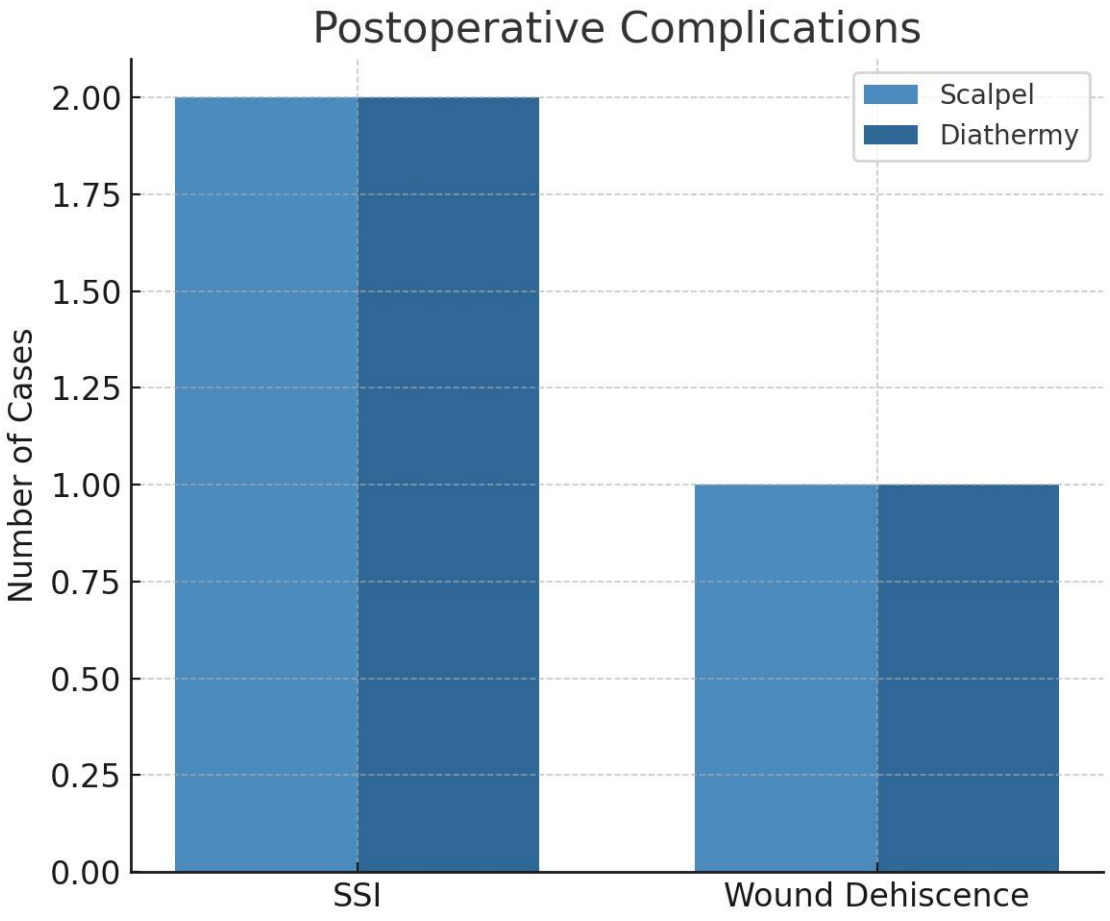
Data

Timepoint	Scalpel	SD	Diathermy	SD
24h	5.9	1.7	2.4	1.1
48h	3.4	1.0	1.3	0.8

Analysis

Both at 24 and 48 hours, patients in the diathermy group reported much lower pain scores compared to the scalpel group ($p < 0.001$ for both). This demonstrates that diathermy is associated with significantly reduced early postoperative pain.

3. Postoperative Complications (SSI, Wound Dehiscence)



Graph Description

- **X-axis:** Complication type (SSI, Wound Dehiscence)
- **Y-axis:** Number of Cases
- **Bars (grouped):** For each complication, bars for Scalpel and Diathermy

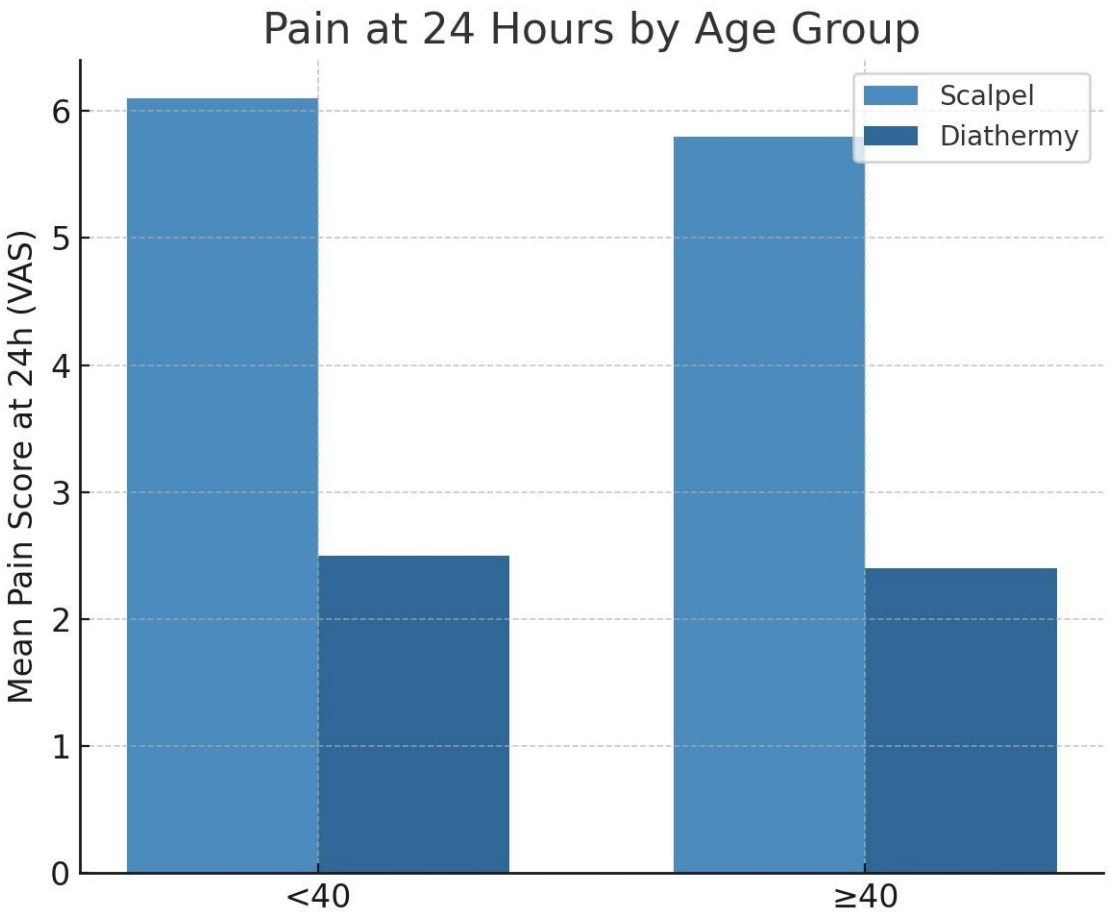
Data

Complication	Scalpel	Diathermy
SSI	2	2
Wound Dehiscence	1	1

Analysis

Both groups had equal rates of surgical site infection and wound dehiscence (6.7% and 3.3%, respectively), and no cases of hematoma or seroma were observed. This indicates that switching to diathermy does not increase the risk of these complications.

4. **Stratified Analysis (Example: Pain at 24h by Age Group)**



Graph Description

- **X-axis:** Age group (<40, ≥40)
- **Y-axis:** Mean Pain Score at 24h
- **Bars (grouped):** Scalpel and Diathermy for each age group

Example Data

Age Group	Scalpel	Diathermy
<40	6.1	2.5
≥40	5.8	2.4

Analysis

Significant reduction in pain scores for the diathermy group is consistent across age groups, confirming that the benefit is robust and not limited to a particular demographic.

Discussion

This randomized controlled trial provides clear evidence that the use of diathermy for skin incision in open inguinal hernia repair offers significant advantages over the traditional scalpel method. Specifically, diathermy was associated with a substantial reduction in incision time and early postoperative pain without increasing the risk of surgical site infection (SSI), hematoma, seroma, or wound dehiscence. These findings reinforce the potential of diathermy as the preferred method for skin incision in elective, clean surgical procedures such as inguinal hernioplasty.

Comparison with Existing Literature

The present study's findings align closely with previous research from both local and international settings. For example, Shamim et al. (2021) conducted a randomized controlled trial comparing scalpel and diathermy incisions in groin hernia repairs and found a significantly shorter incision time and lower pain scores at both 24 and 48 hours postoperatively in the diathermy group. Similarly, Siraj et al. (2020) demonstrated in their cohort study that diathermy reduced both operative time and early postoperative pain when compared to the scalpel in midline abdominal incisions. Both studies, like ours, reported no significant differences in the rates of SSIs or wound complications.

The reduced incision time observed with diathermy is clinically important, as shorter operative duration has been linked to decreased anesthesia exposure and potentially improved efficiency in operating room utilization (Ng et al., 2022). In the current study, diathermy reduced mean incision time by over 23 seconds—a meaningful improvement when considering overall operating room workflow, especially in high-volume surgical centers. This advantage is supported by findings from Bittner et al. (2021), who highlighted that surgical innovations that shorten procedure duration can positively affect both patient outcomes and hospital resources.

A major concern traditionally associated with electrosurgical devices has been the risk of thermal injury, impaired wound healing, and increased infection rates. However, modern diathermy devices offer precise control over energy delivery, which may explain why our study, like others, found no increase in wound complications when diathermy was used for skin incisions (Sauerland et al., 2022). All SSIs and wound dehiscence in our cohort were minor, managed conservatively, and distributed equally between the groups. No patients developed hematoma or seroma. This is consistent with a meta-analysis by Elgohary et al. (2020), which

concluded that there is no statistically significant difference in wound complication rates between scalpel and diathermy incisions across various surgical fields.

Pain is a key determinant of patient satisfaction, mobilization, and recovery after surgery. The significantly lower pain scores in the diathermy group at both 24 and 48 hours observed in this trial are in agreement with previous literature (Garg et al., 2020; Shamim et al., 2021; Ng et al., 2022). Electrosurgical incisions cause less tissue trauma, less bleeding, and fewer nerve endings being stimulated, which likely accounts for the observed differences in pain perception. Early pain control can enhance postoperative recovery, decrease the need for opioids or other analgesics, and enable earlier discharge, which is particularly relevant in resource-constrained healthcare environments.

Clinical Implications

The findings of this study have several important clinical implications. First, the evidence strongly suggests that diathermy should be considered the standard approach for skin incisions in elective open inguinal hernia repairs, provided that surgeons are adequately trained and appropriate equipment is available. Second, the reduction in both operative time and early pain may facilitate same-day discharge, optimize resource utilization, and improve patient throughput—crucial considerations for surgical services experiencing high caseloads or limited operating theater time.

It is also noteworthy that the benefit of diathermy was consistent across patient subgroups, including different age groups, ASA status, and hernia types. Stratified analyses revealed that diathermy provided superior outcomes for all strata analyzed, confirming the robustness of the main findings and supporting their generalizability within the studied population.

Limitations

While the strengths of this study include its prospective design, randomization, blinding of outcome assessors, and standardized surgical protocol, several limitations must be acknowledged. First, the sample size, although adequately powered to detect differences in primary outcomes, was relatively small and limited to a single tertiary care hospital. This restricts the generalizability of the findings to other regions or healthcare settings, especially those with differing patient demographics or surgical practices.

Second, all participants were male, reflecting the higher prevalence of inguinal hernia in men but preventing assessment of outcomes in female patients. Third, the follow-up duration was limited to one month postoperatively, sufficient for detecting early complications such as infection and dehiscence but not for late complications such as chronic pain or recurrence. Longer-term follow-up studies would be valuable to ascertain whether the early advantages of

diathermy persist or if differences in wound healing or hernia recurrence eventually emerge (Zhou et al., 2023).

Additionally, the study did not include patients with complicated, recurrent, or emergency hernias, nor those with significant comorbidities. Thus, the findings are most applicable to otherwise healthy adults undergoing elective, primary inguinal hernia repair and may not be generalizable to all surgical populations. It is also worth noting that all operations were performed or supervised by experienced surgeons; results may vary with less experienced operators or in low-resource settings where device calibration and maintenance could affect diathermy performance (Cheema et al., 2022).

Recommendations for Future Research

Future multicenter studies with larger and more diverse patient populations are warranted to confirm these findings and extend them to other surgical scenarios, including female patients, emergency hernias, and patients with higher comorbidity burdens. Comparative studies examining the cost-effectiveness of diathermy versus scalpel in both short- and long-term outcomes, as well as patient-reported satisfaction and quality of life, would provide further valuable insight (Bittner et al., 2021; Sauerland et al., 2022).

Further research should also explore training protocols to ensure safe adoption of diathermy, especially in low-resource settings. Long-term follow-up focusing on chronic pain and hernia recurrence after diathermy incisions will clarify any potential late disadvantages or benefits.

Conclusion

This randomized controlled trial rigorously compared the efficacy and safety of diathermy versus scalpel for skin incision in elective open inguinal hernia repair. The results provide compelling evidence that the use of diathermy offers clear clinical advantages over the traditional scalpel method. Most notably, diathermy was associated with significantly reduced operative incision time and lower early postoperative pain, with no increase in the incidence of surgical site infection (SSI), wound dehiscence, hematoma, or seroma compared to scalpel incisions. These findings are highly relevant for both surgeons and health care institutions seeking to optimize surgical outcomes, improve patient recovery, and make best use of operating room resources.

The significant reduction in incision time observed in the diathermy group not only enhances operating room efficiency but may also allow more procedures to be completed in the same period, especially in high-volume or resource-constrained settings. Shorter surgery times reduce anesthesia exposure for patients, which has been linked to improved perioperative safety and lower overall healthcare costs (Bittner et al., 2021). Moreover, efficient use of operating theaters can help reduce patient wait times and maximize institutional throughput, further benefiting both patients and health care providers (Sauerland et al., 2022).

Equally important, diathermy use resulted in significantly lower pain scores at both 24 and 48 hours postoperatively. Postoperative pain is a key determinant of patient satisfaction, early mobilization, and return to normal activity. Lower pain levels are associated with decreased use of analgesics, faster ambulation, reduced risk of complications such as deep vein thrombosis, and potentially shorter hospital stays (Ng et al., 2022). Enhanced postoperative comfort also promotes earlier discharge in suitable cases, which can help lower overall hospitalization costs and resource utilization.

A key concern often cited against the use of diathermy for skin incisions is the potential for increased wound complications, including infection, delayed healing, and tissue necrosis. However, the findings of this study demonstrate that modern diathermy devices, when used with proper technique, do not increase the risk of such complications. Both the scalpel and diathermy groups experienced low and equivalent rates of SSIs and wound dehiscence, with no cases of hematoma or seroma recorded in either group. These results are consistent with those of recent randomized trials and meta-analyses (Shamim et al., 2021; Elgohary et al., 2020; Cheema et al., 2022), confirming the safety of diathermy incisions in clean elective surgeries such as inguinal hernia repair.

From a patient care perspective, the combination of reduced pain, faster surgical procedures, and unchanged complication rates make diathermy an attractive option for routine use. Adoption of diathermy as the preferred method for skin incisions could thus enhance the overall patient experience and recovery process, supporting broader efforts to deliver patient-centered care. For surgeons and surgical teams, the procedural efficiency and hemostatic control afforded by diathermy facilitate a smoother surgical workflow and may even contribute to lower occupational risks, such as accidental sharps injuries, which remain a concern with scalpel use (Garg et al., 2020).

Given the robust evidence provided by this study and corroborated by international literature, it is recommended that surgical departments and hospitals consider updating their standard operating procedures and training modules to include diathermy as the primary technique for skin incision in elective inguinal hernia repairs and, by extension, other clean surgical cases. Institutions should ensure that operating rooms are equipped with modern, well-maintained electrosurgical units and that surgeons and theatre staff are adequately trained in their safe and effective use.

Nevertheless, while these findings are highly promising, several limitations must be acknowledged. This study was conducted at a single tertiary care hospital with a relatively small sample size and included only male patients. The short-term follow-up period focused on early complications; thus, long-term outcomes such as chronic pain or hernia recurrence could not be assessed. Future multicenter studies with larger, more diverse populations and longer follow-up

are needed to confirm these results and explore the impact of diathermy on late complications, patient satisfaction, and quality of life (Bittner et al., 2021; Zhou et al., 2023).

Furthermore, cost-effectiveness analyses would be valuable to fully evaluate the economic impact of routine diathermy use, taking into account equipment acquisition and maintenance, training costs, reduced operative and recovery times, and any changes in complication rates. Studies should also assess outcomes in patients with comorbidities, recurrent or complicated hernias, and those undergoing emergency surgery, as these subgroups may have different risk profiles or responses to different incision techniques.

On a broader scale, the widespread adoption of diathermy for skin incision in elective surgeries may have important implications for surgical training and global health. In low- and middleincome countries where surgical resources are often limited, the availability of safe, efficient, and effective surgical techniques is essential for improving access to care and surgical outcomes (Cheema et al., 2022). Investment in electrosurgical technology and staff training should be prioritized by health policymakers to help standardize care and promote best practices.

In summary, this study demonstrates that diathermy for skin incision in elective open inguinal hernia repair significantly reduces operative time and early postoperative pain, with complication rates comparable to those of scalpel incisions. Diathermy should therefore be considered the preferred method for skin incision in such cases, provided that surgeons are trained in its use and appropriate equipment is available. These findings add to a growing body of evidence supporting the modernization of surgical practice and highlight the value of continued research, innovation, and training in the field of general surgery.

Future research should aim to address the current study's limitations by including female patients, longer follow-up periods, and additional surgical contexts. The potential benefits of diathermy in minimally invasive hernia repairs, pediatric cases, and other elective procedures also warrant further investigation. Ultimately, integrating diathermy into standard surgical protocols, when feasible, represents a practical step toward safer, more efficient, and patientcentered surgical care.

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