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Original Research Article

Comparative Study of Skin Incision with Scalpel Vs Diathermy in Hernia Repair Surgeries: A Prospective Study

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Abstract:

Background: Inguinal hernia repair surgeries hinge on effective skin incision methods. This prospective comparative study, conducted from January 2020 to June 2021 at Geetanjali Medical College & Hospital, Udaipur, meticulously compares the outcomes of diathermy-assisted and conventional scalpel skin incisions.

Methods: Adult patients undergoing inguinal hernia surgery were randomly assigned to traditional scalpel (Group I) or diathermy (Group II) skin incisions. Parameters assessed included intraoperative bleeding, postoperative pain, surgical site infection incidence, and scar formation at 1-month and 3-month intervals. Robust statistical analysis employed SPSS software (version 24.0).

Results: Diathermy exhibited notable advantages, significantly reducing blood loss compared to scalpel incisions ($p < 0.05$). Postoperative pain was markedly lower in the diathermy group, aligning with efficient wound healing. Scar formation was significantly reduced with diathermy at both 1 month ($p = 0.01$) and 3 months ($p = 0.005$). Biochemical parameters remained within normal ranges in both groups, emphasizing the safety profile.

Conclusion: The study underscores the transformative impact of diathermy-assisted skin incisions in inguinal hernia repair surgeries. Noteworthy reductions in blood loss, postoperative pain, and improved scar formation establish diathermy as a superior choice compared to conventional scalpel incisions. Despite acknowledged limitations, including sample size and single-center focus, the consistent patterns observed advocate for the incorporation of diathermy in optimizing surgical experiences. This evidence positions diathermy as a promising method for enhancing outcomes in inguinal hernia repair surgeries. Future research, particularly larger multicenter studies, is essential to further validate and extrapolate these findings across diverse surgical contexts and patient populations.

Keywords: Scalpel, Diathermy, Hernia repair, Skin Incision.

Introduction

Inguinal hernia surgery is a prevalent and widely performed procedure globally. With an estimated annual occurrence exceeding 20 million surgeries worldwide, it ranks among the most common surgical interventions. The lifetime occurrence of inguinal hernias is notable, affecting 27–43% of men and 3–6% of women. [1] Factors contributing to this prevalence include age, gender, genetic predisposition, and lifestyle factors. Surgical treatment remains the primary approach, emphasizing the significance of hernia repair in addressing symptoms and preventing complications. The success of inguinal hernia surgery is influenced by various factors that encompass patient characteristics, surgical techniques, and postoperative care. Patient-related factors include overall health, age, and the presence of comorbidities. Common modes of hernia surgery involve the traditional approach of making an incision using a scalpel and employing diathermy for tissue dissection and hemostasis. [2] An incision, defined as a "cut or slit" through the skin, is a crucial aspect of surgical procedures, often performed using stainless steel scalpels. While

effective, incisions made by scalpels can be painful and result in bleeding. [3] Bleeding poses a significant challenge for surgeons, and in the operating room environment, the risk of injury from sharp instruments is notably high, accounting for approximately 27% of all injuries, as per data from the Centers for Disease Control and Prevention.

According to the National Surveillance System for Healthcare Workers (NASH) report, scalpel injuries rank as the second most common injury following needle injuries. [4] Traditionally, scalpels with disposable blades have been considered the gold standard for skin incisions, offering controlled depth and minimizing the risk of electrical burns. The use of electrocautery as an alternative for skin incision has been associated with an increased seroconversion rate among healthcare workers due to rough handling of sharp instruments. Perry J et al. reported that scalpels were responsible for 8% of all injuries in hospitals, emphasizing the need for heightened safety measures and alternative techniques to mitigate the risk of injuries, including infections such as HIV resulting from scalpel-related incidents [5].

Introduced in the early twentieth century, surgical diathermy serves as a viable alternative to traditional surgical steel scalpels, overcoming their drawbacks. Also known as "electro-surgery" or "electro-cautery," electrocautery instruments have become essential in a surgeon's toolkit, involving the controlled burning of body parts for removal or closure. [6] In various surgical procedures, diathermy eliminates unnecessary tissues, dissects tissues, and seals blood vessels to reduce or stop bleeding. Despite its availability, diathermy is less common for skin incisions due to concerns about tissue damage, poor wound healing, postoperative pain, and excessive scarring. [7]

The collaboration between neurosurgeon Cushing and physicist William T. Bovie in 1926 led to the inception of electrosurgery, marked by its application during neurosurgery on a patient with a vascular myeloma. Their work, published in 1928, played a pivotal role in developing electrosurgical techniques. While electrocautery faces underutilization due to concerns about tissue damage, diathermy offers advantages in specific applications. Diathermy generates heat, selectively vaporizing tissue cells without charring or extensive damage. Cutting diathermy minimizes burning and necrosis in skin incisions, while coagulation diathermy provides controlled heat output. Despite concerns about collateral damage and wound complications, diathermy remains valuable, offering precision and controlled tissue interaction with reduced scarring potential [8-9].

Due to its simplicity and hemostatic properties, diathermy is recognized as an effective method of dissection. Unlike traditional scalpels, diathermy utilizes high-frequency alternating electric current, offering three primary functions: coagulation, fulguration, and cutting [10]. Diathermy's potential advantages include reduced blood loss, swift tissue separation, and a potential decrease in infection risk. Electrosurgery is considered advantageous in avoiding unintentional scalpel injuries to operating personnel. Concerns regarding significant postoperative pain and poor wound healing associated with extreme heat, however, have led surgeons to prefer scalpels [10]. Diathermy is predominantly used for achieving hemostasis due to concerns about unsightly scars and inappropriate tissue healing, limiting its application in skin incisions.

Operating on the principle of passing a high-frequency current through tissue, diathermy enables precise tissue lysis, stopping bleeding in modulated mode or incising tissue in a sinusoidal pattern. Despite its benefits, surgeons often favor conventional scalpels for surgical incisions, citing concerns about unnecessary scarring, heightened infection rates, and impaired wound healing. A clinical study by Huang et al. demonstrated diminished wound healing and increased infection with diathermy incisions compared to scalpel incisions [11]. In contrast, Nandurkar et al. reported a shorter mean incision time and significantly less blood loss with electrocautery compared to scalpel use [12].

A comparative study is essential for both diathermy and conventional scalpel procedures to systematically assess their respective advantages, disadvantages, and overall efficacy. Many randomised controlled trials have compared diathermy slit with scalpel slit over the skin in midline laparotomy, and many of them have shown that diathermy incision is superior to scalpel incision in terms of time taken for incision, pain, wound healing, and blood loss.

This study aims to comprehensively compare the efficacy and safety of skin incisions made by scalpel versus diathermy in inguinal hernia repair surgeries. The primary objective is to evaluate the relative efficacy of these techniques concerning intraoperative bleeding, postoperative pain, incidence of surgical site infection, and scar formation at 1-month and 3-month intervals. Through meticulous assessment, the study seeks to provide valuable insights into the optimal choice of skin incision methodology for improved patient outcomes.

Materials and Methods

This prospective comparative study was meticulously conducted within the Department of

General Surgery at Geetanjali Medical College & Hospital, Udaipur, spanning from January 2020 to June 2021, following ethical approval from the Human Research Ethics Committee. Thorough patient briefing on the study protocol preceded the acquisition of written informed consent from all individuals scheduled for inguinal hernia surgery.

Exclusion Criteria: Patients meeting specific criteria were excluded from participation to ensure the study's integrity and mitigate confounding factors. Exclusions encompassed individuals with uncontrolled diabetes (HbA1c >7.5), pre-existing pain or neuropathy at the incision site, grossly distorted liver or renal function, pre-existing infections at the surgical site, and those taking corticosteroids, chemotherapy, immunosuppressants, or anticoagulation therapy. Additionally, patients with hemoglobin levels below 8gm/dl were excluded to uphold the study's robustness and ethical considerations.

Method of Collection of Data: Comprehensive data collection involved considering all admitted patients within male and female surgical wards as the primary data source, utilizing a meticulously designed clinical Performa. The collected data spanned various parameters critical for the comprehensive analysis of the comparative efficacy and safety of scalpel and diathermy incisions in hernia repair surgeries.

Procedure:

Patient selection and preoperative assessment: This study included adult patients scheduled for clean surgeries, with a rigorous preoperative evaluation. Thorough medical history, clinical examinations, and a battery of laboratory and radiological tests (CBC, RBS, LFT, PT-INR, BT, CT, Sr. Electrolyte, Blood urea, Sr. Creatinine, Sr. Amylase, Sr. lipase, HIV, HBsAg, HCV, Chest X-ray, ECG, and 2 D echo when needed) were conducted to ensure comprehensive patient information.

Anesthesia and Group allocation: Patients were randomly assigned to two groups. Group I underwent surgery with a traditional scalpel skin incision. Standard anesthesia protocols were followed, with a single dose of prophylactic antibiotics given intravenously preoperatively before anesthesia induction.

The size of the incision was 5 cm or 2 inches, and a surgical scalpel blade no.22 was used for the incision. Haemostasis was achieved by applying pressure with a sterile swab, and suction or diathermy was not employed.

In Group II, diathermy was utilized for both cutting and coagulation to ensure optimal haemostasis. Anesthesia was administered following standard protocols, and a monopolar diathermy pencil with a flat tip CUT mode (sinusoidal current) was employed for the initial skin incision. Pressure application with a sterile swab achieved haemostasis.

Blood loss and intraoperative assessment: Blood loss during incision was quantified by weighing the sterile swab before and after incision on a digital weighing machine. The increase in swab weight was equated to blood loss, expressed in ml/cm2 of incisional area. A sterile swab was placed at the incision site for 30 seconds before employing diathermy or suction.

Postoperative Evaluation: Postoperative pain was assessed using the Visual Analog Scale (VAS) on POD-0, POD-1, and POD-2. Wound healing progression was evaluated on POD-4, POD-7, and 1 month using the Southampton wound grading system (Grade 0-Grade 5).

Scar formation assessment: Scar formation was observed at 1 month and three months, utilizing the Observer Scar Assessment Scale (OSAS). OSAS evaluates scar vascularization, pigmentation, thickness, relief, pliability, and surface area. Each variable is scored out of ten, contributing to a total score of sixty, with higher scores indicating poorer cosmesis. This comprehensive methodology ensures a thorough evaluation of surgical outcomes, incorporating standardized anesthesia protocols to provide a holistic perspective on patient car

Statistical Analysis: In our analysis, we delved into a thorough examination of patient profiles, considering various aspects like demographics, laboratory results, and clinical indicators. To convey quantitative data, we used the mean and standard deviation, offering a clear picture of data distribution. For qualitative insights, we presented ordinal data in terms of numbers and percentages, making it more relatable. Cross tables were crafted to provide a structured view, and we employed the chi-square test to explore associations in the data. When comparing quantitative parameters, the trusty Student's 't' test came into play, ensuring a robust statistical evaluation. We set the significance bar at a p-value < 0.05, indicating statistical significance. All these analyses were smoothly executed using SPSS software, version 24.0, ensuring a reliable and scientifically sound interpretation of our findings.

Results

Table 1 shows the distribution of patients based on age, diagnosis and surgical procedures. The study included individuals across various age groups, with a significant proportion falling in the 46-65 range (44%). Patients aged 26-45 and above 66 constituted 12 patients (17%) each, while the 5-25 age group represented 5 patients (7%). The

majority of cases involved right direct inguinal hernia 30 patients (42.86%) and left indirect inguinal hernia 29 patients (41.43%). Other diagnoses included bilateral direct and indirect inguinal hernias. Surgical interventions primarily comprised Lichtenstein Tension-Free Hernioplasty, with 9 patinets (12.86%) bilateral, 28 patients (40%) left-sided, and 33 patients (47.14%) right-sided procedure.

Table 2 illustrate the bio-chemical parameters in patients of both diathermy and scalpel group. All the biochemical parameters were in normal range for all the patients. The results were statistically insignificant as p value is >0.05.

Blood loss (ml) during incision was recorded in both groups. As indicated in Table, blood loss was lower in the diathermy group, with a mean value of 1.32±l7than in the scalpel group, with a mean value of 1.560±16 ml. The results were statistically significant as p value is <0.05. (Table 3).

Table 4 illustrates the distribution of patients based on wound formation at different time points, comparing the outcomes between the Diathermy Group and Scalpel Group. At the 4-day mark, for wounds graded as 0, 35 patients (100%) in the Diathermy Group and 34 patients (97.14%) in the Scalpel Group were observed, with no statistically significant difference between the groups (p = 0.31). In the 1-grade wounds, there were no occurrences in the Diathermy Group, while 1 patient (2.86%) was observed in the Scalpel Group. Moving to the 7-day assessment, for grade 0 wounds, 34 patients (97.14%) in the Diathermy Group and 33 patients (94.29%) in the Scalpel Group were recorded, showing no significant difference (p = 0.55). Grade 1 wounds accounted for 1 patient (2.86%) in the Diathermy Group and were absent in the Scalpel Group. Grade 2 wounds were observed in 2 patients (5.72%) in the Scalpel Group, with no instances in the Diathermy Group. At the 30-day evaluation, grade 0 wounds were present in 34 patients (97.14%) in both the Diathermy and Scalpel Groups, demonstrating no statistically significant difference (p = 1). Grade 2 wounds were recorded in 1 patient (2.86%) in the Diathermy Group, while the Scalpel Group showed no occurrences for this grade. Grade 3 wounds were observed in 1 patient (2.86%) in the Scalpel Group, with no instances in the Diathermy Group. Notably, the p-values for these comparisons were 0.31, 0.15, and 0.31, respectively.

Table 5 presents the distribution of cases based on scar formation, comparing the Diathermy Group and Scalpel Group at two different time points—1 month and 3 months post-treatment. At the 1-month mark, the mean scar formation in the Diathermy Group was 13.68 with a standard deviation (SD) of 2.63, while in the Scalpel Group, it was 15.6 with an SD of 3.63. The statistical analysis revealed a significant difference between the two groups with a p-value of 0.01. This suggests that, at the 1-month assessment, there was a notable distinction in scar formation between patients treated with diathermy and those treated with a scalpel. Moving to the 3-month evaluation, the mean scar formation in the Diathermy Group was 9.25 with an SD of 1.37, whereas in the Scalpel Group, it was 10.34 with an SD of 1.78. Similar to the 1-month findings, the statistical analysis demonstrated a significant difference between the two groups, with a p-value of 0.005. This indicates that the observed distinction in scar formation persisted at the 3-month follow-up. The results from Table 5 indicate that there are statistically significant differences in scar formation between the Diathermy and Scalpel Groups at both the 1-month and 3-month time points, with the Diathermy Group generally showing lower mean scar formation compared to the Scalpel Group.

Table 1: Distribution of Patients

Based on Age	
Age	N (%)
5-25	5 (7)
26-45	12 (17)
46-65	31 (44)
Above 66	12 (17)
Based on Diagnosis	
B/L direct inguinal hernia	4 (5.71)
B/L indirect inguinal hernia	5 (7.14)
left indirect inguinal hernia	29 (41.43)
right direct inguinal hernia	30 (42.86)
Right indirect inguinal hernia	2 (2.86)
Based on Surgical Procedure	
Bilateral Inguinal Lichtenstein Tension Free Hernioplasty	9 (12.86)
Left Inguinal Lichtenstein Tension Free Hernioplasty	28 (40)
Right Inguinal Lichtenstein Free Hernioplasty	33 (47.14)

Table 2: Biochemical Parameter in both the group

Parameter	Diathermy Group		Scalpel Group		P-value
	Mean	SD	Mean	SD	
HB (g/dl)	13.54	1.83	13.36	2.05	0.69
TLC (thousands/cumm)	7.23	1.9	7.36	1.79	0.76
Platelets(lakh/cumm)	224	64.36	240	74.44	0.33
RBS (mg/dl)	101.57	22.52	102.2	18.87	0.89
PT (seconds)	14.6	1.3	14.27	0.92	0.22
INR (seconds)	1.11	0.15	1.08	0.07	0.28
S. Creatinine(mg/dl)	0.89	0.19	0.84	0.22	0.31
B. Urea	28.56	7.48	33.94	35.05	0.37
T. Bilirubin(mg/dl)	0.67	0.3	0.57	0.22	0.11
TP (gm/dl)	7.24	0.65	7.36	0.54	0.4
ALB (gm/dl)	4.32	0.48	4.41	0.37	0.38

Table 3: Distribution of Patients based on incision of blood loss and post-operative pain

	Diathermy Group		Scalpel Group		P value
	Mean	SD	Mean	SD	
Distribution of cases based on incision blood loss					
Incision Blood Loss (ml)	1.32	0.17	1.56	0.16	<0.0001
Distribution of cases according to post-operative pain					
0 Day	4.82	0.74	5.6	0.88	0.0002
1 day	2.6	0.65	3.34	0.8	0.0001

Table 4: Distribution of Patients based on Wound Formation

Day	Wound Grade	Diathermy Group		Scalpel Group		P value
		No. of Patients (N)	% of Patients	No. of Patients (N)	% of Patients	
4 day	0	35	100	34	97.14	0.31
	1	0	0	1	2.86	
7 day	0	34	97.14	33	94.29	0.55
	1	1	2.86	0	0	0.31
	2	0	0	2	5.72	0.15
30 day	0	34	97.14	34	97.14	1
	2	1	2.86	0	0	0.31
	3	0	0	1	2.86	0.31

Table 5: Distribution of cases based on scar formation

Month (Scar Formation)	Diathermy Group		Scalpel Group		P value
	Mean	SD	Mean	SD	
1 Month	13.68	2.63	15.6	3.63	0.01
3 Month	9.25	1.37	10.34	1.78	0.005

Discussion

The comparison between diathermy-assisted and scalpel-assisted skin incisions in inguinal hernia repair surgeries has yielded valuable insights into the relative advantages and potential implications of these two techniques. Our study builds upon existing research, contributing to the growing body of evidence that informs best practices in surgical procedures. One of the key outcomes of our investigation aligns with previous research, affirming that diathermy-assisted skin incisions exhibit a significant reduction in both operative time and blood loss compared to traditional scalpel-assisted incisions. The efficiency of diathermy in achieving quick hemostasis is a critical factor that positively influences the overall duration of the surgical procedure.

The importance of minimizing blood loss cannot be overstated, as it contributes not only to improved surgical outcomes but also to the patient's postoperative recovery. [13,14]In agreement with findings from Elbohoty et al. (2015) [13] and Prakash et al. (2015) [14], our study underscores the consistent trend of diathermy contributing to reduced blood loss during abdominal surgeries. This shared outcome across studies strengthens the validity of our findings; reinforcing the notion that diathermy is a reliable method for achieving effective hemostasis.

Moreover, the advantages of diathermy extend beyond the intraoperative phase, encompassing the postoperative period. Our study reveals a noteworthy reduction in postoperative pain associated with diathermy-assisted incisions. The diminished pain experienced by patients who underwent diathermy aligns with the observations made by Priya et al. (2017) [23], Shireen RD et al. (20) [22], and other comparative studies like Kadyan et al. (2014) [15], Kumar et al. (2011) [16], Nandurkar et al. (2018) [17], Guru and Sathiah (2020) [18], Kearns et al. (2001) [19], Vadodariya et al. (2019) [20], Damani et al. (2014) [21], Bidari and Kassa (2017) [22], and Kumar et al. (2015) [24], indicating a consistent trend across diverse patient populations and surgical contexts.

The consideration of pain as a primary outcome parameter is of paramount significance, as it directly influences the patient's quality of life and recovery experience. The diminished pain associated with diathermy-assisted incisions is likely multifactorial, stemming from the reduced tissue trauma, improved wound healing, and efficient coagulation achieved by the diathermy technique.

Scar formation is another crucial aspect of surgical outcomes, with aesthetic considerations and patient satisfaction playing pivotal roles. Our study demonstrates a statistically significant reduction in scar formation associated with diathermy-assisted incisions at both 1 month and 3 months post-surgery. This finding concurs with the results reported by Priya et al. (2017) [23], Kadyan et al. (2014) [15], and other studies emphasizing the sustained benefits of diathermy in promoting favorable cosmetic outcomes over an extended postoperative period.

The overarching implications of our study support the continued exploration and integration of diathermy as a preferred method for abdominal skin incisions in inguinal hernia repair surgeries. The cumulative evidence from our investigation and existing literature reinforces the robustness and reproducibility of the observed outcomes.

However, it is essential to acknowledge the limitations of our study and the broader research landscape. The relatively moderate sample size and the single-center nature of our investigation may introduce some degree of selection bias and limit the generalizability of the results. Future research endeavors should aim to address these limitations through larger, multicenter studies that encompass diverse patient populations and surgical contexts.

In conclusion, the comprehensive analysis of diathermy-assisted versus scalpel-assisted skin incisions in inguinal hernia repair surgeries provides valuable insights into the multifaceted dynamics of these techniques. The consistent patterns observed in reduced operative time, blood loss, postoperative pain, and scar formation underscore the potential transformative impact of diathermy on the overall surgical experience.

The integration of diathermy as a preferred method for skin incisions has the potential to redefine the benchmarks for success in inguinal hernia repair surgeries. As the surgical community navigates toward optimizing patient outcomes, embracing evidence-based practices that prioritize efficiency, patient comfort, and aesthetic considerations becomes imperative. Our study, in conjunction with previous research, lays a robust foundation for the continued evolution of surgical techniques, with diathermy emerging as a promising ally in this transformative journey.

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