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NERVE MANAGEMENT AND CHRONIC PAIN AFTER OPEN INGUINAL HERNIA REPAIR: A PROSPECTIVE STUDY

Original Research

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ABSTRACT

Background: Chronic postoperative inguinal pain (CPIP) is a prevalent complication following open inguinal hernia repair, significantly impacting patient quality of life. The incidence of CPIP varies widely across studies, with risk factors including nerve injury, preoperative pain intensity, and surgical technique. Effective perioperative nerve management strategies may play a crucial role in reducing chronic pain. However, the relationship between specific nerve handling techniques and long-term pain outcomes remains unclear. This study investigates the impact of different nerve management strategies on CPIP incidence.

Objective: To evaluate the effects of perioperative nerve identification, preservation, and adjunctive interventions on chronic pain outcomes six months after open inguinal hernia repair.

Methods: A prospective cohort study was conducted from September 2022 to March 2024 at the Department of Surgery, CMH Rawalpindi. A total of 57 patients undergoing elective open inguinal hernia repair were enrolled through consecutive sampling. Perioperative nerve management strategies, including identification, preservation, neurolysis, and neurectomy, were assessed. Pain levels were measured using the Visual Analog Scale (VAS) at multiple time points, with standardized assessments conducted by blinded evaluators. Follow-ups were performed at six months and one year postoperatively. The primary outcome was the incidence of CPIP at six months, with secondary outcomes including postoperative pain severity, nerve identification rates, and pain medication usage.

Results: At six months, chronic pain was reported in 14 patients (24.6%), while 43 patients (75.4%) remained pain-free. Preoperative pain severity was significantly associated with CPIP development ($p = .03$), with 50.0% of chronic pain cases having reported very strong preoperative pain. Strong postoperative pain at one week (VAS 7–10) was more frequent in patients with CPIP (64.3% vs. 30.2%, $p = .04$). Nerve identification showed a significant correlation with reduced CPIP incidence, with the iliohypogastric ($p = .01$) and ilioinguinal nerves ($p = .02$) identified more frequently in patients without chronic pain. However, no significant association was found between CPIP and the type of anesthesia ($p > .05$) or specific nerve management techniques such as neurolysis and neurectomy ($p > .05$).

Conclusion: CPIP remains a prevalent concern after open inguinal hernia repair, with preoperative and early postoperative pain severity emerging as significant risk factors. Nerve identification during surgery was associated with a lower incidence of CPIP, emphasizing the need for meticulous intraoperative nerve management. The findings support a patient-centered approach incorporating preoperative pain assessment, early postoperative pain control, and careful nerve preservation strategies to optimize surgical outcomes and minimize chronic pain.

Keywords: Anesthesia, Chronic Pain, Hernia Repair, Iliohypogastric Nerve, Ilioinguinal Nerve, Nerve Management, Postoperative Pain

INTRODUCTION

Chronic pain following open inguinal hernia repair remains a significant concern, impacting patients' postoperative quality of life and overall surgical outcomes. With reported incidences reaching as high as 53%, chronic postoperative pain is recognized as the most common complication after inguinal hernia surgery (1,2). This pain is typically classified into somatic and neuropathic types, with both forms contributing to long-term discomfort and disability (3,4). Among the critical factors influencing postoperative pain, perioperative nerve management has gained increasing attention for its potential role in reducing chronic pain (5). The ilioinguinal, iliohypogastric, and genital branch of the genitofemoral nerves are particularly susceptible to injury during hernia repair, with their handling during surgery being a subject of ongoing debate (6). While some studies suggest that nerve preservation minimizes the risk of chronic pain, others advocate for selective nerve division to prevent nerve entrapment, leading to conflicting recommendations regarding optimal nerve management strategies (7). The Lichtenstein technique, one of the most widely employed methods for open inguinal hernia repair, involves the placement of a synthetic mesh, which may inadvertently contact nerves, potentially leading to long-term pain syndromes (8). Various surgical modifications have been proposed to mitigate the incidence of chronic pain, emphasizing meticulous nerve identification and preservation while minimizing unnecessary neurolysis. In addition to intraoperative strategies, perioperative interventions such as nerve blocks, particularly inguinal nerve blocks, have shown promise in enhancing postoperative pain control and improving patient recovery (9). Although laparoscopic approaches and neurectomy techniques have been explored as alternatives, their long-term efficacy in preventing chronic pain remains an area of ongoing investigation (10).

Despite advancements in surgical techniques, chronic postoperative pain continues to be a challenge, necessitating further research to establish evidence-based perioperative nerve management strategies. This study aims to examine the impact of various nerve handling approaches, including nerve identification, preservation, and the use of adjunctive interventions, on chronic pain outcomes following open inguinal hernia repair. By providing a comprehensive analysis of these strategies, this research seeks to optimize surgical protocols and perioperative pain management, ultimately improving patient outcomes and reducing the burden of chronic pain associated with hernia repair.

METHODS

A prospective cohort study was conducted from September 2022 to March 2024 at the Department of Surgery, Combined Military Hospital (CMH) Rawalpindi, Pakistan. Eligible participants were identified preoperatively and enrolled based on predefined inclusion and exclusion criteria. A total of 76 patients undergoing elective open inguinal hernia repair were initially recruited; however, 12 individuals declined participation, and seven were lost to follow-up, leaving a final cohort of 57 patients for analysis. A consecutive sampling technique was used to ensure the inclusion of all eligible patients meeting the criteria within the study period. Ethical approval was obtained from the Ethical Committee of Combined Military Hospital Rawalpindi, and written informed consent was obtained from all patients and their next of kin prior to study enrollment. Patients were included if they had primary groin hernias scheduled for elective surgical repair. Exclusion criteria encompassed cases with recurrent hernias, strangulation, or incarceration. For patients with bilateral hernias, surgeries were performed separately with a minimum six-week interval between procedures, ensuring independent follow-up assessments. Hernias were classified using the Aachen hernia classification system (11). Patients with small hernias (LI, LII, and MI) and no recurrence risk underwent a modified Shouldice repair, whereas those with larger defects (LIII, MII, and MIII) or a higher risk of recurrence received Lichtenstein repair. All procedures were performed by experienced hernia surgeons.

Standardized perioperative nerve management techniques were employed, focusing on nerve preservation to minimize the risk of chronic pain. The iliohypogastric nerve (IHN), ilioinguinal nerve (IIN), and the genital branch of the genitofemoral nerve (GB) were carefully identified and preserved when feasible. Neurolysis was performed selectively for nerve preservation, while neurectomy was conducted in cases of significant nerve damage. Patients were stratified into two cohorts based on postoperative pain outcomes at six months: those with chronic pain and those without. Pain was assessed using the Visual Analog Scale (VAS) at standardized postoperative time points. To minimize assessment bias, pain evaluations were conducted by blinded evaluators who were not involved in the surgical procedures. Additional patient data included demographic characteristics, hernia classification, preoperative pain status, acute postoperative pain

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scores, comorbidities, surgical techniques, intraoperative nerve handling, and postoperative pain outcomes. Analgesic consumption and surgical complications were systematically recorded.

Follow-up evaluations were conducted at six months and one year postoperatively. At six months, all patients underwent a comprehensive physical examination and pain assessment. At one-year, standardized follow-up was conducted for all participants, irrespective of symptoms, to mitigate selection bias and ensure a complete analysis of long-term outcomes. A structured questionnaire was administered at both follow-up intervals to assess pain characteristics, including intensity, duration, frequency, location, and impact on daily activities. Patients reporting chronic pain were further interviewed regarding treatment strategies and quality-of-life implications. Those experiencing sensory abnormalities provided detailed symptom descriptions. The primary outcome measure was the incidence of disabling pain or numbness at six months and one year postoperatively. Secondary outcomes included variations in pain intensity, frequency, and duration, patient satisfaction, return to daily activities, and analgesic consumption. Postoperative complications, including wound-related issues and hernia recurrence, were documented. This study aimed to provide robust evidence on the impact of perioperative nerve management strategies on chronic pain following open inguinal hernia repair by utilizing a well-defined cohort design, standardized pain assessments, and comprehensive long-term follow-up of all participants.

RESULTS

Among the 57 patients included in the final analysis, the majority were within the age group of 41–50 years, comprising 30 individuals (52.6%), followed by those aged ≥50 years, accounting for 22 individuals (38.6%). Only five patients (8.8%) were younger than 40 years. In terms of BMI distribution, 47 patients (82.5%) were classified as overweight, while 8 (14.0%) had a healthy weight, 1 (1.8%) was underweight, and 1 (1.8%) was obese. Gender distribution indicated that 37 patients (64.9%) were female, whereas 20 (35.1%) were male. Preoperatively, mild pain was reported by 37 individuals (64.9%), moderate pain by 11 (19.3%), strong pain by 1 (1.8%), and very strong pain by 8 (14.0%). Regarding the type of anesthesia, general anesthesia was administered to 37 patients (64.9%), while local anesthesia was used in 20 patients (35.1%). The Lichtenstein repair was the predominant surgical procedure, performed in 46 cases (80.7%), whereas the Shouldice repair was utilized in 11 cases (19.3%). Preoperative sensory disturbances were reported in 21 patients (36.8%), while the majority, 36 patients (63.2%), had no sensory deficits. Postoperatively, pain medication demand varied, with 21 patients (36.8%) requiring low-demand medication, 17 (29.8%) requiring moderate-demand medication, and 19 (33.4%) requiring high-demand medication. At one-week post-surgery, 21 patients (36.8%) experienced strong postoperative pain (VAS 7–10), whereas 36 patients (63.1%) reported lower pain levels (VAS 1-6). Identification of the iliohypogastric nerve was achieved in 53 cases (93.0%), while 4 cases (7.0%) lacked identification. Similarly, the ilioinguinal nerve was identified in 51 cases (89.5%) and not identified in 6 cases (10.5%). Nerve preservation techniques were the most frequently employed strategy for both the iliohypogastric nerve (preserved: 32 cases, 56.1%; neurectomy: 20 cases, 35.1%; neurolysis: 5 cases, 8.8%) and the ilioinguinal nerve (preserved: 37 cases, 64.9%; neurectomy: 9 cases, 15.8%; neurolysis: 11 cases, 19.3%). Similarly, the genital branch of the genitofemoral nerve was preserved in 37 cases (64.9%), while neurectomy was performed in 8 cases (14.0%) and neurolysis in 12 cases (21.1%).

At six months postoperatively, chronic pain was reported in 14 patients (24.6%), while the majority, 43 patients (75.4%), remained pain-free. Analysis of factors contributing to chronic pain showed no significant difference between the type of surgical procedure and chronic pain incidence (Lichtenstein: 85.7% vs. 79.1%, $p = .45$). However, a significant association was observed between preoperative pain severity and chronic pain at six months ($p = .03$), with 50.0% of patients experiencing chronic pain having reported very strong preoperative pain, compared to 14.0% in those without chronic pain. A significant association was also noted for strong postoperative pain at one week ($p = .04$), with 64.3% of patients who developed chronic pain experiencing high-intensity pain at this early stage, compared to 30.2% in those without chronic pain. Furthermore, identification of the iliohypogastric nerve ($p = 0.01$) and ilioinguinal nerve ($p = 0.02$) were significantly associated with chronic pain outcomes, with a higher proportion of patients without chronic pain having documented nerve identification. Nerve management strategies (preservation, neurectomy, neurolysis) and postoperative paraesthesia were not significantly correlated with chronic pain development (all $p > .05$). At one-year follow-up, chronic pain persisted in 10 patients (17.5%), reflecting a slight improvement from the six-month mark where 14 patients (24.6%) had reported chronic pain. Pain-free cases increased from 43 patients (75.4%) at six months to 47 patients (82.5%) at one year. Functional recovery also improved, with 42 patients (73.7%) reporting a return to normal activities compared to 35 patients (61.4%) at six months. The proportion of patients experiencing strong pain (VAS 7–10) decreased from 21 cases (36.8%) at six months to 12 cases (21.1%) at one year, while those reporting low pain (VAS 1–3) increased from 19 cases (33.4%) to 33 cases (57.9%). Opioid analgesic use declined from 15 patients (26.3%) at six months to 7 patients (12.3%) at one year, suggesting reduced pain severity and reliance on strong analgesics. Concurrently,

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non-opioid analgesic use increased from 42 patients (73.7%) to 50 patients (87.7%), indicating a shift towards milder pain management strategies. These findings highlight an overall trend of pain reduction, functional recovery, and decreased dependence on opioid medications over time.

Table 1: Demographic characteristics of the study sample (n=57)

Variable	N (percentage)
Age	
>40 years	5 (8.8%)
41-50 years	30 (52.6%)
≥50 years	22 (38.6%)
BMI	
underweight	1 (1.8%)
healthy weight	8 (14%)
overweight	47 (82.5%)
obese	1 (1.8%)
Gender	
Male	20 (35.1%)
Female	37 (64.9%)

Table 2: Clinical and health-related characteristics of the study sample (n=57)

Variable	N (percentage)
Type of Surgery	
Lichtenstein	46 (80.7%)
Shouldice	11 (19.3%)
Sensory Disorder	
Yes	21 (36.8%)
No	36 (63.2%)
Preoperative pain	
Mild pain	37 (64.9%)
Moderate	11 (19.3%)
Strong	1 (1.8%)
Very strong	8 (14%)
Type of Anesthesia	
Local	20 (35.1%)
General	37 (64.9%)
Postoperative pain medication	
Low demand	21 (36.8%)

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Variable	**N (percentage)**
Moderate demand	17
High demand	19
Strong post-op pain at 1 week	
Yes (VAS 7–10)	21
No (VAS 1-6)	36
Iliohypogastric identification	
Yes	53
No	4
Ilioinguinal nerve Identification	
Yes	51
No	6
Iliohypogastric nerve	
Preservation	32
Neurectomy	20
Neurolysis	5
Ilioinguinal nerve	
Preservation	37
Neurectomy	9
Neurolysis	11
Genital branch	
Preservation	37
Neurectomy	8
Neurolysis	12

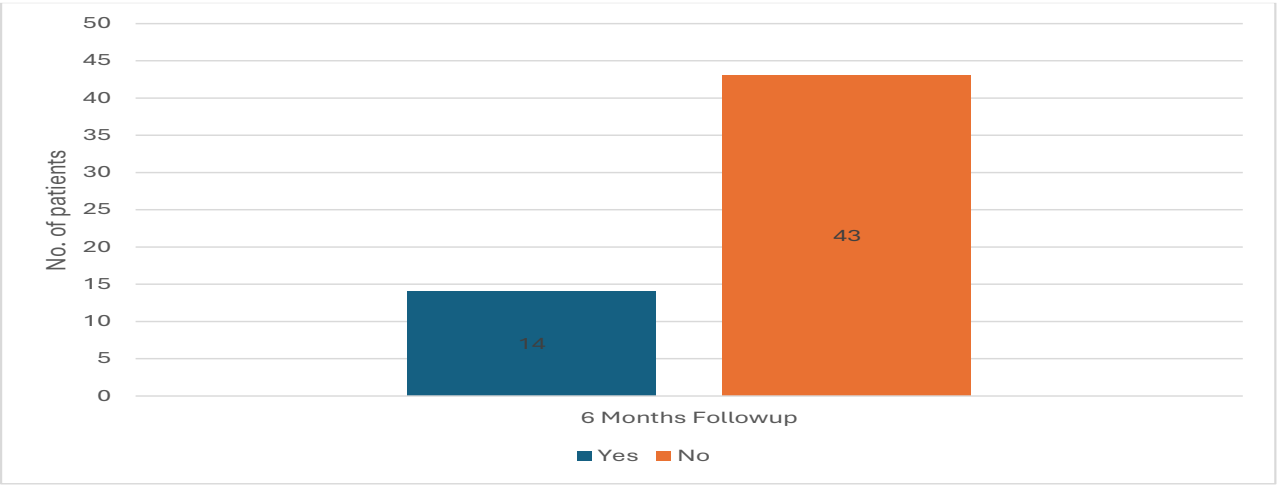


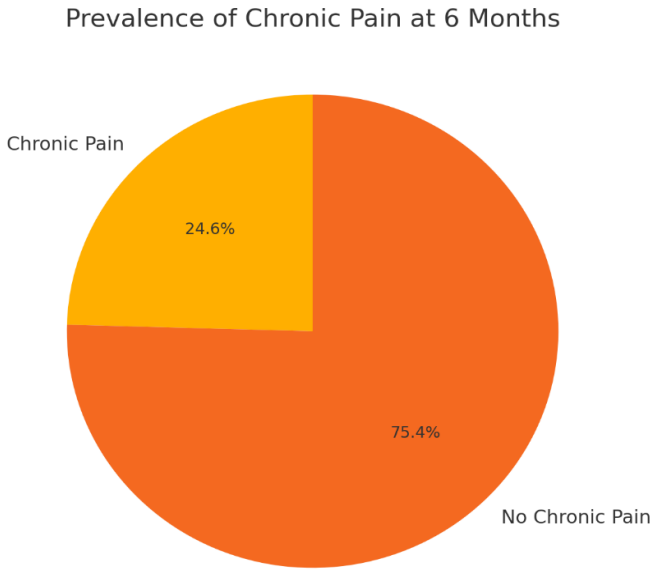
Figure 1. Prevalence of chronic pain

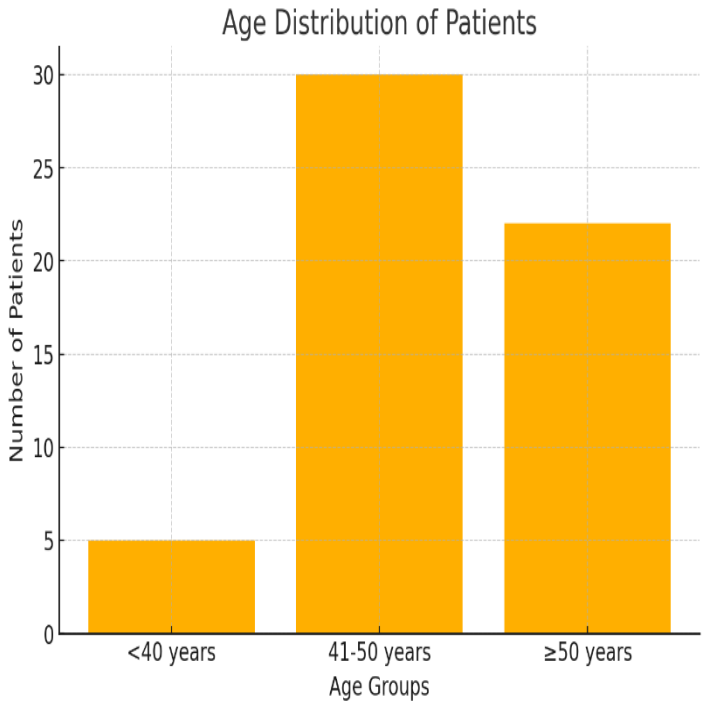
Table 3: Clinical factors and chronic pain among study participants

Variables	Group 1 (Chronic Pain) N=14	Group 2 (No Chronic Pain) N=43	P value
Type of Surgery			
Lichtenstein	12 (85.7%)	34 (79.1%)	0.45
Shouldice	2 (14.3%)	9 (20.9%)	
Preoperative pain			
Mild pain	1 (7.1%)	36 (83.7%)	.03*
Moderate	5 (35.7%)	6 (14%)	
Strong	1 (7.1%)	1 (2.3%)	
Very strong	7 (50%)	36 (83.7%)	
Postoperative pain medication			
Low demand	4 (28.6%)	17 (39.5%)	0.48
Moderate demand	6 (42.9)	11 (25.6%)	
High demand	4 (28.6%)	15 (34.9%)	
Strong post-op pain at 1 week			
Yes (VAS 7–10)	9 (64.3%)	13 (30.2%)	.04*
No (VAS 1-6)	6 (35.7%)	30 (69.8%)	
Iliohypogastric identification			
Yes	10 (71.4%)	43(100%)	0.01*
No	4 (28.5%)	-	
Ilioinguinal nerve Identification			
Yes	-	43 (100%)	0.02*
No	14 (100%)	-	
Iliohypogastric nerve			
Preservation	6 (42.9%)	26 (60.5)	0.67
Neurectomy	7 (50%)	13 (13.2)	
Neurolysis	1 (7.1%)	4 (9.3%)	
Ilioinguinal nerve			
Preservation	10 (71.4%)	27 (62.8%)	0.41
Neurectomy	3 (21.4%)	6 (14%)	
Neurolysis	1 (7.1%)	10 (23.3%)	
Genital branch			

Variables	Group 1 (Chronic Pain) N=14	Group 2 (No Chronic Pain) N=43	P value
Preservation	9 (64.3%)	28 (65.1%)	0.56
Neurectomy	3 (21.4%)	5 (11.6%)	
Neurolysis	2 (14.3%)	10 (23.3%)	
Post op paresthesia			
Yes	13 (92.9%)	39 (90.7%)	0.64
No	1 (7.1%)	4 (9.3%)	

*= P<0.05





DISCUSSION

Chronic pain following open inguinal hernia repair remains a well-documented concern in surgical practice, with reported prevalence varying across studies. In this study, chronic pain was observed in 24.6% of patients at six months postoperatively, a rate higher than that documented in most previous literature, which reports prevalence between 1% and 16% (12-15). Multiple factors could account for this discrepancy, including variations in surgical techniques, differences in nerve identification and management approaches, and patient-related factors such as individual pain thresholds and preexisting conditions. Disparities in follow-up protocols and definitions of chronic pain across studies may also contribute to these variations. Understanding these discrepancies is crucial for refining surgical strategies and postoperative pain management protocols. Postoperative pain management is integral to enhancing recovery, minimizing complications, and improving overall patient outcomes. Effective pain control has been shown to mitigate stress responses and expedite recovery after surgery (16). The European Hernia Society recommends local anesthesia for adult patients undergoing open inguinal hernia repair (17). In this study, most patients received local anesthesia, aligning with these guidelines. However, findings revealed no significant association between anesthesia type and chronic pain development, suggesting that intraoperative nerve handling and individual pain responses may play a more significant role in long-term pain outcomes.

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Preoperative pain severity emerged as a key determinant of chronic pain development. Patients with higher preoperative pain levels demonstrated an increased likelihood of experiencing persistent postoperative pain, reinforcing the need for thorough preoperative pain assessment and management. Strong postoperative pain at one week was also significantly associated with chronic pain at six months, highlighting the importance of early postoperative pain control. These findings align with previous research indicating that higher acute postoperative pain intensity correlates with an elevated risk of chronic pain (18,19). Early identification and targeted management of patients reporting severe postoperative pain could potentially reduce long-term pain complications. The role of nerve handling in chronic pain development has been widely debated. In this study, identification of the iliohypogastric and ilioinguinal nerves was significantly associated with reduced chronic pain incidence. Patients without chronic pain had a higher rate of nerve identification, suggesting that nerve visualization during surgery may have a protective effect. However, nerve management techniques, including preservation, neurolysis, and neurectomy, did not show a significant impact on chronic pain outcomes. These findings are consistent with previous research indicating that while nerve handling is an important consideration, other factors, such as pain thresholds and inflammatory responses, may also influence chronic pain development (20-22). A meta-analysis examining nerve management strategies similarly reported no definitive advantage of neurectomy over preservation in preventing chronic pain, though a trend toward lower chronic pain rates with nerve identification was noted (23). These findings emphasize the complex interplay of neural, inflammatory, and patient-specific factors in chronic pain pathogenesis.

The multifactorial nature of chronic postoperative inguinal pain necessitates a comprehensive approach to prevention and management. Younger age, female sex, preoperative pain intensity, and certain mesh types have been identified as contributing factors to postoperative pain persistence (20). While this study primarily focused on nerve handling and pain severity, future research should explore additional predictive factors such as inflammatory markers, genetic predisposition, and psychosocial influences. Addressing these variables could provide a more holistic understanding of chronic pain mechanisms and inform personalized perioperative management strategies. A key strength of this study is its prospective design, standardized pain assessments, and comprehensive nerve identification data. The inclusion of blinded evaluators for pain assessment minimized bias and strengthened the reliability of findings. However, several limitations must be acknowledged. The relatively small sample size may limit generalizability, and the study's single-center design could introduce institutional practice biases. Additionally, long-term follow-up beyond one year would provide further insights into the persistence and resolution of chronic pain over time. Future studies with larger, multicenter cohorts and extended follow-up periods could enhance the understanding of chronic pain trajectories and refine surgical and postoperative pain management protocols.

The findings of this study underscore the importance of preoperative pain assessment, early postoperative pain control, and meticulous nerve identification in mitigating chronic pain following open inguinal hernia repair. While nerve handling remains a subject of debate, this study suggests that nerve identification rather than specific management strategies may play a protective role. Given the multifactorial nature of chronic pain, a multidisciplinary approach integrating surgical, anesthetic, and patient-specific strategies is essential to optimize outcomes and improve long-term patient well-being.

CONCLUSION

This study highlights the substantial burden of chronic postoperative inguinal pain following open hernia repair, emphasizing its multifactorial nature. The findings underscore the critical role of preoperative pain severity and intraoperative nerve identification in influencing long-term pain outcomes, while factors such as anesthesia type and specific nerve management techniques did not demonstrate a significant impact. These results reinforce the need for a patient-centered approach, integrating thorough preoperative pain assessment, meticulous surgical technique, and individualized postoperative pain management strategies. Addressing these factors can contribute to optimizing surgical outcomes, reducing chronic pain prevalence, and improving the overall quality of life for patients undergoing inguinal hernia repair.

AUTHOR CONTRIBUTIONS

Author	Contribution
Osama Iqbal*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Waseem Ahmed Khan	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Syed Mukarram Hussain	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Hamna Anwar	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Gufran Ahmed	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Salman Faiz	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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