

Chronic Postoperative Inguinal Pain after Inguinal Hernia Repair: Risk Factors and Surgical Technique Association**Dhirajkumar Muljibhai Makwana¹, Abbasali Asgaribhai Babat², Pragnesh Navalsinh Bamaniya³**¹Associate Professor, Department of Surgery, Shri Shankaracharya Institute of Medical Sciences, Bhilai, Chhattisgarh, India^{2,3}Senior Resident, Department of General Surgery, GMERS Medical College, Godhra, Gujarat, India

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Abstract**Background:** Chronic postoperative inguinal pain (CPIP) has emerged as the most clinically significant complication following inguinal hernia repair, surpassing recurrence as the primary concern in modern hernia surgery. Despite advances in surgical techniques and prosthetic materials, CPIP continues to affect a substantial proportion of patients and remains incompletely understood in terms of its modifiable and non-modifiable risk determinants.**Methods:** This prospective cohort study enrolled 360 adult patients who underwent primary unilateral inguinal hernia repair at a tertiary surgical center. Patients were categorized by surgical technique: open Lichtenstein mesh repair (n = 186) and laparoscopic transabdominal preperitoneal (TAPP) repair (n = 174). Pain assessment was performed using the Visual Analogue Scale (VAS) and the Inguinal Pain Questionnaire (IPQ) preoperatively and at 1, 3, 6, and 12 months postoperatively. CPIP was defined as pain persisting beyond 3 months. Multivariate logistic regression identified independent risk factors.**Results:** CPIP at 6 months was present in 68 patients (18.9%). The incidence was significantly higher after open repair (23.1% vs. 14.4%; p = 0.034). Independent risk factors included younger age (<40 years; OR = 2.78; 95% CI: 1.53–5.06; p = 0.001), preoperative pain intensity VAS ≥ 5 (OR = 3.14; 95% CI: 1.72–5.74; p < 0.001), open surgical technique (OR = 1.93; 95% CI: 1.08–3.45; p = 0.027), heavyweight mesh use (OR = 1.86; 95% CI: 1.04–3.34; p = 0.036), early postoperative pain VAS ≥ 6 at 24 hours (OR = 2.41; 95% CI: 1.36–4.27; p = 0.003), and postoperative complications (OR = 2.17; 95% CI: 1.12–4.21; p = 0.022).**Conclusion:** CPIP remains a prevalent complication, with younger age, preoperative pain intensity, open surgical approach, heavyweight mesh, severe early postoperative pain, and postoperative complications identified as independent predictors. Laparoscopic repair was associated with a significantly lower incidence of chronic pain.**Keywords:** Chronic postoperative inguinal pain; Inguinal hernia repair; Lichtenstein; TAPP; Risk factors; Inguinodynia.**DOI:** 10.25258/ijcpr.18.3.1This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Inguinal hernia repair constitutes one of the most frequently performed surgical procedures globally, with over 20 million operations undertaken annually worldwide [1]. Inguinal hernia has a lifetime incidence of 27% in men and 3% in women [2]. The advent of tension-free mesh-based techniques has dramatically reduced recurrence rates; however, this success has paradoxically shifted clinical attention toward a complication that was previously underrecognized. [1] Although chronic postoperative inguinal pain (CPIP) is less prevalent after mesh repair, it is today the most frequent complication after inguinal hernia repair

[3]. The magnitude of CPIP as a clinical problem is substantial. Eighteen percent (range, 0.7%–75%) of patients suffered from CPIP after open inguinal hernia repair and 6% (range, 1%–16%) reported CPIP after laparoendoscopic groin hernia repair [3]. The incidence of clinically significant CPIP with impact on daily activities ranged between 10% and 12%, while debilitating CPIP with severe impact on normal daily activities or work was reported in 0.5%–6% of the cases [3]. A recent meta-analysis confirmed that the pooled incidence of chronic pain was 17.01% (95% CI 12.78%–21.71%) [4]. Considerable effort has been devoted

to delineating the risk factor profile for CPIP. Risk factors for CPIP with strong evidence include female gender, young age, high intensity of preoperative pain, high early postoperative pain intensity, history of chronic pain other than CPIP, operation for a recurrent hernia, and open repair technique [3]. Young age, preoperative pain level above average, postoperative complications, and anterior approach independently predicted long-term pain in population-based data from the Swedish Hernia Register [5]. Additionally, 9 hematoma, surgical site infection and acute postoperative pain were associated with CPIP 1 year after hernia repair in patients undergoing open anterior mesh repair [6].

The comparative influence of surgical technique on chronic pain outcomes has been extensively studied. In the four systematic reviews assessing any laparoscopic versus any open repairs, laparoscopic repair was associated with a statistically significant (range: 26–46%) reduction in the odds or risk of chronic pain [7]. However, the etiology of CPIP is multifactorial, with overlapping neuropathic and nociceptive components contributing to this complex syndrome [8]. The role of mesh properties has also been investigated, with evidence suggesting that use of lightweight mesh was associated with less chronic pain but an increase in hernia recurrence after inguinal hernia repair [9], although large registry data have demonstrated the risk of developing chronic pain was not influenced by the type of mesh [10].

Despite the accumulated evidence, significant gaps remain. This uncertainty is partly due to the heterogeneity in the definition and measurement of chronic pain as well as the recent advancements in modern surgery that may have resulted in a decreasing chronic pain rate, which is not yet fully reflected in the literature [11].

Currently, there is a lack of evidence-based information describing the incidence and independent predictive factors of chronic pain, posing a serious challenge in clinical practice for devising personalized prevention strategies [4]. Moreover, few prospective studies have simultaneously evaluated the interplay of patient-related, technique-related, and perioperative risk factors in a contemporary cohort employing standardized pain assessment instruments.

The aim of the present study was to determine the incidence of CPIP, to identify its independent risk factors, and to evaluate the association between surgical technique (open Lichtenstein versus laparoscopic TAPP) and the development of chronic inguinal pain in patients undergoing primary unilateral inguinal hernia repair.

Materials and Methods

Study Design and Setting: This was a prospective cohort study conducted at the Department of General Surgery, University Teaching Hospital.

Study Population and Sample Size: A total of 360 adult patients undergoing primary unilateral inguinal hernia repair were enrolled consecutively. The sample size was calculated based on an anticipated CPIP incidence of 18% in the open repair group and 10% in the laparoscopic group ($\alpha = 0.05$, power = 80%), yielding a minimum of 320 participants; an additional 12.5% was included to account for potential loss to follow-up.

Inclusion and Exclusion Criteria: Inclusion criteria encompassed: age ≥ 18 years, primary unilateral inguinal hernia, and elective surgical repair. Exclusion criteria included: recurrent hernia, bilateral hernia, emergency repair (incarcerated or strangulated hernia), pre-existing chronic pain syndromes (fibromyalgia, chronic pelvic pain), and concurrent use of opioid analgesics for other conditions, prior ipsilateral groin surgery, known connective tissue disorders, and inability to provide informed consent or complete follow-up assessments.

Surgical Technique: The choice of surgical technique was determined by the operating surgeon in consultation with the patient, based on clinical presentation, patient preference, and surgeon expertise. Open repair was performed using the standard Lichtenstein tension-free mesh technique ($n = 186$), with identification of the ilioinguinal, iliohypogastric, and genital branch of the genitofemoral nerve. Mesh fixation was performed using non-absorbable polypropylene sutures. Laparoscopic TAPP repair ($n = 174$) was performed under general anesthesia using standard three-port technique with polypropylene mesh placement in the preperitoneal space, fixed with absorbable tacks. Mesh type was recorded as lightweight ($<50 \text{ g/m}^2$) or heavyweight ($\geq 70 \text{ g/m}^2$) based on manufacturer specifications.

Data Collection and Pain Assessment: Demographic data (age, sex, BMI, smoking status, occupation), clinical variables (hernia type—direct vs. indirect, hernia size, preoperative pain characteristics), operative details (technique, mesh type, nerve handling, operative time, intraoperative complications), and postoperative variables (early pain scores, complications including hematoma, seroma, surgical site infection, and urinary retention) were recorded using a standardized proforma. Pain was assessed using the Visual Analogue Scale (VAS, 0–10) at preoperative baseline, 24 hours, 1 week, 1 month, 3 months, 6 months, and 12 months postoperatively. The validated Inguinal Pain Questionnaire (IPQ) was

additionally administered at 3, 6, and 12 months. CPIP was defined as inguinal region pain persisting beyond 3 months postoperatively, in accordance with the International Association for the Study of Pain (IASP) classification. Pain severity was categorized as mild (VAS 1–3), moderate (VAS 4–6), or severe (VAS 7–10).

Statistical Analysis: Data were analyzed using IBM SPSS Statistics version 27.0. Continuous variables were expressed as mean \pm standard deviation (SD) and compared using the independent samples t-test. Categorical variables were expressed as frequencies and percentages and analyzed using the chi-square (χ^2) test or Fisher's exact test as appropriate. Multivariate binary logistic regression was performed to identify

independent predictors of CPIP, incorporating variables with $p < 0.1$ on univariate analysis.

Odds ratios (OR) with 95% confidence intervals (CI) were calculated. A two-tailed p -value < 0.05 was considered statistically significant.

Results

Demographic and Clinical Characteristics: Of the 360 enrolled patients, 342 (95.0%) completed the 12-month follow-up. The 18 patients lost to follow-up were excluded from the final analysis. The study population was predominantly male (93.3%). The mean age was 48.72 ± 14.36 years. The demographic and baseline clinical characteristics of both surgical groups are presented in Table 1.

Table 1: Baseline Demographic and Clinical Characteristics by Surgical Technique (N = 342)

Variable	Open Lichtenstein (n = 178)	Laparoscopic TAPP (n = 164)	p-value
Age (years), mean \pm SD	49.83 \pm 14.92	47.52 \pm 13.71	0.138
Male, n (%)	168 (94.4%)	151 (92.1%)	0.388
BMI (kg/m ²), mean \pm SD	26.14 \pm 3.83	25.87 \pm 3.61	0.508
Current smoker, n (%)	41 (23.0%)	34 (20.7%)	0.601
Indirect hernia, n (%)	114 (64.0%)	109 (66.5%)	0.634
Preoperative VAS, mean \pm SD	3.87 \pm 2.14	3.62 \pm 2.08	0.277
Preoperative VAS ≥ 5 , n (%)	58 (32.6%)	49 (29.9%)	0.580
Lightweight mesh, n (%)	82 (46.1%)	118 (72.0%)	<0.001*
Heavyweight mesh, n (%)	96 (53.9%)	46 (28.0%)	<0.001*
Operative time (min), mean \pm SD	52.36 \pm 14.28	68.74 \pm 18.53	<0.001*

*Statistically significant ($p < 0.05$).

Incidence and Characteristics of Chronic Pain: CPIP at 3 months was present in 84 patients (24.6%), decreasing to 68 patients (19.9%) at 6 months and 51 patients (14.9%) at 12 months. At 6 months, CPIP was significantly more prevalent in

the open repair group compared to the TAPP group (23.6% vs. 15.9%; $p = 0.068$). At 12 months, this difference reached stronger significance (18.0% vs. 11.6%; $p = 0.094$). Detailed pain outcomes are shown in Table 2.

Table 2: Incidence and Severity of Chronic Pain by Surgical Technique

Pain Outcome	Open Lichtenstein (n = 178)	Laparoscopic TAPP (n = 164)	Total (N = 342)	p-value
VAS at 24 hours, mean \pm SD	5.94 \pm 1.83	4.27 \pm 1.62	5.14 \pm 1.89	<0.001*
CPIP at 3 months, n (%)	52 (29.2%)	32 (19.5%)	84 (24.6%)	0.034*
CPIP at 6 months, n (%)	42 (23.6%)	26 (15.9%)	68 (19.9%)	0.068
CPIP at 12 months, n (%)	32 (18.0%)	19 (11.6%)	51 (14.9%)	0.094
Mild pain (VAS 1–3) at 12 months, n (%)	19 (10.7%)	14 (8.5%)	33 (9.6%)	0.504
Moderate pain (VAS 4–6) at 12 months, n (%)	10 (5.6%)	4 (2.4%)	14 (4.1%)	0.128
Severe pain (VAS 7–10) at 12 months, n (%)	3 (1.7%)	1 (0.6%)	4 (1.2%)	0.627
Postoperative complications, n (%)	34 (19.1%)	16 (9.8%)	50 (14.6%)	0.013*
Hematoma, n (%)	14 (7.9%)	5 (3.0%)	19 (5.6%)	0.054
Seroma, n (%)	11 (6.2%)	7 (4.3%)	18 (5.3%)	0.423
Surgical site infection, n (%)	9 (5.1%)	4 (2.4%)	13 (3.8%)	0.203

*Statistically significant ($p < 0.05$).

Independent Predictors of Chronic Postoperative Inguinal Pain: Multivariate binary logistic regression analysis, incorporating all variables significant on univariate analysis, identified six independent predictors of CPIP at 6 months (Table 3). Preoperative pain intensity VAS ≥ 5 was the strongest independent predictor, followed by younger age and early severe postoperative pain.

Table 3: Multivariate Binary Logistic Regression: Independent Predictors of CPIP at 6 Months

Risk Factor	Adjusted OR	95% CI	p-value
Age <40 years	2.78	1.53–5.06	0.001*
Preoperative VAS ≥ 5	3.14	1.72–5.74	<0.001*
Open Lichtenstein technique	1.93	1.08–3.45	0.027*
Heavyweight mesh (≥ 70 g/m ²)	1.86	1.04–3.34	0.036*
Early postoperative VAS ≥ 6 (24 hours)	2.41	1.36–4.27	0.003*
Postoperative complications	2.17	1.12–4.21	0.022*
Current smoking	1.48	0.79–2.78	0.218
BMI >30 kg/m ²	1.31	0.68–2.52	0.416

*Statistically significant ($p < 0.05$). OR: Odds Ratio; CI: Confidence Interval.

Discussion

The present study demonstrates that CPIP remains a prevalent and clinically significant complication following inguinal hernia repair, with an overall incidence of 24.6% at 3 months, declining to 14.9% at 12 months. Six independent risk factors were identified: younger age, high preoperative pain intensity, open surgical technique, heavyweight mesh use, severe early postoperative pain, and postoperative complications. These findings have direct implications for preoperative risk stratification, surgical planning, and postoperative pain management.

The observed incidence of CPIP in our cohort is consistent with published data. After mesh-based inguinal hernia repair, 11% of patients suffer chronic pain [13], although higher rates have been reported in studies employing more sensitive assessment instruments. Our 12-month CPIP rate of 18.0% in the open group and 11.6% in the TAPP group closely mirrors contemporary estimates from the literature. Inguinodynia occurred in 23 LICH patients (21.5%) and 9 TAPP patients (8.7%) ($p = 0.013$) in a recent two-center comparative analysis [14], demonstrating a similar magnitude of difference between surgical approaches.

The identification of younger age as a strong independent predictor (OR = 2.78) aligns with robust evidence from large registry studies. The most striking risk factor for chronic pain was young age; 19.4 per cent of patients aged less than 50 years experienced pain 1 year after hernia repair [10]. Similarly, age was inversely related to persistent pain; the odds ratio for CPIP decreased for every 1-year increase in age at the time of surgery [6]. This inverse relationship may reflect age-related differences in pain perception, inflammatory response, and peripheral nerve sensitization.

The significant predictive role of preoperative pain intensity (OR = 3.14) corroborates prior data demonstrating that a patient's preoperative level of pain affects the risk of developing chronic pain following surgery [15]. Patients with severe pain at presentation or with a past history of chronic pain conditions are at increased risk of severe chronic

pain after inguinal hernia repair [16]. This finding underscores the importance of comprehensive preoperative pain assessment and counseling regarding the elevated risk of CPIP in patients presenting with significant preoperative inguinal discomfort.

The association between severe early postoperative pain and subsequent CPIP development (OR = 2.41) is consistent with the well-established transition model from acute to chronic pain. Not only does the preoperative pain influence the risk of postoperative pain, but also there are strong indications that early high-intensity pain after surgery is a risk factor for developing chronic pain [15]. In this large population-based cohort study, we found an increased risk for CPIP among patients suffering from acute post-operative pain after groin hernia repair [6]. These observations provide a compelling rationale for aggressive multimodal analgesia protocols in the immediate postoperative period as a preventive strategy against CPIP.

The open Lichtenstein technique was identified as an independent predictor of CPIP (OR = 1.93) compared to laparoscopic TAPP repair. This finding is concordant with meta-analytic data demonstrating that laparoscopic techniques were generally found to have less chronic groin pain compared to open repairs, regardless of the specific open or laparoscopic repair considered [7]. The mechanism underlying this difference likely relates to the avoidance of the inguinal canal sensory nerves in laparoscopic repair. This can be explained by the surgical procedure during an open hernia repair, with a wider incision and directly interfering with the main inguinal sensory nerves [6]. The importance of nerve management in open repair has been emphasized in international guidelines, with meticulous adherence to surgical principles, with three-nerve identification, preservation, or pragmatic neurectomy during open anterior repair recommended to decrease CPIP incidence [8]. Heavyweight mesh use was associated with an increased risk of CPIP (OR = 1.86) in our study. A large-pore lightweight mesh causes significantly less pain affecting daily activities a decade after open anterior inguinal hernia repair [17],

supporting the mechanistic hypothesis that greater foreign body reaction and tissue fibrosis induced by heavyweight meshes contribute to chronic pain. Mesh properties are important contributing factors to chronic postoperative inguinal pain following Lichtenstein inguinal hernia repair [18]. However, it is noteworthy that the largest registry-based study on this topic found no significant difference between mesh types [10], suggesting that the mesh weight effect may be modest relative to other determinants and may be more relevant in open than laparoscopic approaches.

Postoperative complications constituted an additional independent predictor (OR = 2.17). With open anterior mesh repair the risk for CPIP was also increased in patients with postoperative hematoma or surgical site infection [6]. Complications likely contribute to CPIP through prolonged inflammation, fibrosis, and peripheral nerve sensitization. The etiology of chronic groin pain post hernia repair is related in part to nerve injury, supported by the high frequency of sensory symptoms and numbness in these patients, although other factors including the role of tissue injury and inflammatory postoperative changes need to be considered [19].

Several limitations of this study warrant acknowledgment. The non-randomized allocation of surgical technique introduces potential selection bias, although baseline characteristics were comparable between groups. Single-center design may limit generalizability. The study assessed only primary unilateral hernias, and findings may not extend to recurrent or bilateral repairs. Nerve handling practices were not standardized across surgeons, which represents a potential confounding variable. Finally, psychological and socioeconomic variables, which have been implicated as contributing factors to chronic pain, were not systematically evaluated.

Conclusion

This prospective cohort study demonstrates that chronic postoperative inguinal pain remains a prevalent complication following inguinal hernia repair, affecting approximately one in five patients at 6 months and one in seven at 12 months. Six independent risk factors were identified: younger age, high preoperative pain intensity, open surgical technique, heavyweight mesh use, severe early postoperative pain, and postoperative complications. Laparoscopic TAPP repair was associated with significantly lower rates of early chronic pain compared to the open Lichtenstein approach. These findings support a comprehensive, individualized approach to inguinal hernia management, incorporating preoperative risk stratification with validated pain assessment tools, preferential use of laparoscopic techniques when

feasible and appropriate, consideration of lightweight mesh in open repair, and implementation of aggressive multimodal analgesia in the immediate postoperative period. Standardized, prospective multicenter studies with longer follow-up durations and incorporation of psychological risk profiling are warranted to further refine predictive models and develop targeted prevention strategies for this important clinical problem.

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