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# Modified Lichtenstein hernioplasty with concomitant tissue repair: a retrospective study on postoperative chronic pain

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## Abstract

**Objective** To assess the effectiveness of a modified Lichtenstein Repair combined with Herniorrhaphy in reducing postoperative chronic pain and enhancing recovery and quality of life in inguinal hernia patients.

**Methods** This retrospective study, conducted at the Taleghani training center between January 2021 and February 2023, retrospectively examined 289 hernia surgeries, of which 130 employed a modified Lichtenstein technique. The investigation encompassed a detailed analysis of patient demographics, employed surgical techniques, operative methods with a focus on minimal dissection, and an evaluation of postoperative outcomes.

**Results** In this study of 289 participants, primarily males aged 60–80 years, the modified technique group demonstrated a notably lower incidence of hernia recurrence (1.5%) compared to the Lichtenstein group (3.1%). Additionally, the modified technique was more effective in reducing postoperative pain, with a significantly lower mean Visual Analogue Scale (VAS) score of 0.15, compared to 0.31 in the Lichtenstein group. This suggests enhanced patient comfort and a potentially quicker recovery in the modified technique group.

**Conclusion** The modified Lichtenstein hernioplasty technique, characterized by minimal tissue trauma and precise mesh placement, emerges as an effective approach in inguinal hernia repair. It offers significant benefits in reducing postoperative discomfort and chronic pain, thereby enhancing patient recovery and overall quality of life. This method aligns with current surgical trends towards patient-centric and minimally invasive procedures.

**Keywords** Inguinal hernia, Inguinodinia, Quality of life, Chronic pain, Modified hernioplasty

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## Introduction

Inguinal hernia repair is a critical surgical intervention globally, with an estimated 20 million procedures performed each year [1]. These hernias, characterized as protrusions of abdominal contents through weakened areas of the abdominal wall, significantly affect patients' well-being and daily functionality [2, 3]. Predominantly impacting males, who have a lifetime risk of 27%, in contrast to females at 3%, inguinal hernias account for approximately 75% of all abdominal wall hernias [4, 5]. The principal aim of hernia repair surgeries is to relieve discomfort and pain, thereby enhancing patients' quality of life [6, 7].

The surgical techniques for inguinal hernia repair are varied, with each method seeking to rectify the hernia sac and fortify the abdominal wall's integrity [8]. Despite the plethora of available techniques, a standardized approach to inguinal hernia repair remains elusive. Consequently, the International Guidelines of the Hernia Surge Group and the European Hernia Society (EHS) endorse personalized treatment plans, tailored to the specific needs of patients, the resources at hand, and the expertise of the surgeon [9]. Among the prevalent techniques is the open mesh Lichtenstein method, noted for its recurrence rate of under 4% [10, 11]. However, the variation in its execution, especially in terms of mesh size, type, and suture placement, suggests a lack of standardized practice [12]. Concurrently, minimally invasive laparoscopic methods are increasingly being adopted [13].

Chronic postoperative pain is a significant concern in hernia repair, influencing both patient recovery and quality of life [14]. Defined as pain persisting for over three months post-surgery, chronic pain affects between 10% and 30% of patients [15, 16]. Approximately 15% of patients report a decline in quality-of-life following surgery [17]. Various interventions, such as modifications in mesh securing within the Lichtenstein hernioplasty, have been explored to alleviate postoperative pain [18–20]. Notably, the incidence of severe chronic postoperative groin pain, impacting daily activities, ranges between 10% and 12% [21].

This study explores a novel adaptation of the Lichtenstein hernioplasty, integrating careful posterior wall repair. Our unit's method employs nonabsorbable mesh with nonabsorbable sutures, focusing on tension-based repair. This retrospective study assesses the effectiveness of the modified Lichtenstein Repair, combined with Herniorrhaphy, in reducing postoperative chronic pain over three years. The goal is to enhance postoperative recovery and patient quality of life.

## Methodology

This retrospective study was conducted at the Taleghani training center from January 2021 to February 2023, focusing on the evaluation of hernia surgeries performed under elective conditions. Specifically, the study analyzed 289 surgeries involving two surgical techniques: 130 cases using a modified method and 159 using the classic Lichtenstein technique as detailed in Fig. 1. The choice of technique—between the classic Lichtenstein and the Modified procedure—was made based on patient preference, which was informed through detailed preoperative consultations ensuring informed consent. Ethical approval was secured from the institutional review board, adhering to stringent ethical standards and maintaining patient confidentiality.

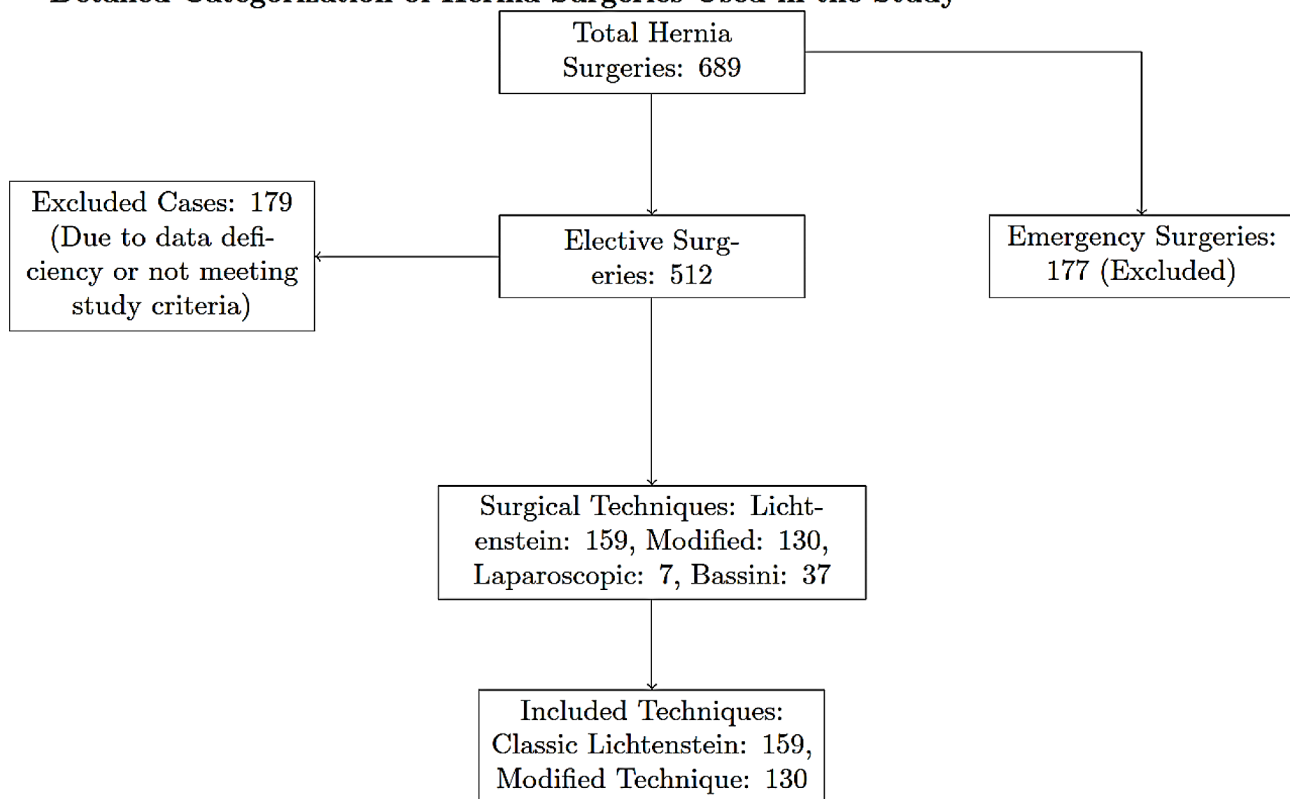
The standardized training protocol for residents, led by senior residents or professors, was crucial in ensuring uniformity and precision in the surgical techniques. This training regimen included comprehensive hands-on practice and theoretical education. Its implementation across surgeries prior to the analysis period was instrumental in guaranteeing the consistency and reliability of the surgical data collected.

Demographic data, including age, gender, BMI, comorbidities, and postoperative complications, were meticulously recorded. These details were crucial for assessing the impact of patient characteristics on the surgical outcomes. The inclusion criteria were specifically designed to include elective hernia surgeries (both unilateral and bilateral) on patients below 80 years with mild comorbidities. Exclusion criteria encompassed emergency procedures, morbid obesity, patients over 80, those with comorbidities that could impair wound healing, as well as patients with collagen diseases or presenting with incarcerated or strangulated inguinal hernias.

## Operative technique

In this study, the operative method for hernia repair was designed to emphasize minimal dissection at all stages of the procedure, enhancing recovery and reducing complications. The procedure began with a skin incision just above the inguinal ligament. This incision was made parallel to the ligament and was superficial, involving only the skin, carefully measured to precisely match the ligament's length. The separation of subcutaneous tissue adhered to hemostatic principles, minimizing tissue trauma. This was conducted in the same orientation as the incision and was sufficient to expose the external oblique fascia, which was then incised using surgical scissors. In a divergence from traditional Lichtenstein hernioplasty, the upper half of the internal oblique muscle was intentionally not dissected, aiming to minimize postoperative discomfort and reduce the risk of muscle damage. The dissection avoided the floor of the inguinal canal

### Detailed Categorization of Hernia Surgeries Used in the Study



**Fig. 1** Flowchart illustrating the detailed categorization of hernia surgeries at Taleghani training center from January 2021 to February 2023. The chart shows the division into elective and emergency surgeries, exclusions due to data deficiency or study criteria not met, and the specific surgical techniques analyzed on the study

and the transversalis fascia, focusing instead on creating adequate space for mesh placement towards the lateral side of the pubic tubercle. Extensive dissection above the myopectineal orifice was deliberately avoided to diminish tissue trauma and decrease the potential for postoperative pain and infection risks. A light polypropylene mesh measuring 10×5 cm was utilized, which is smaller compared to the standard used in classic Lichtenstein technique. This choice was informed by current surgical literature and our clinical experience, which suggest that a smaller mesh can effectively prevent hernia recurrence while potentially reducing postoperative discomfort and complications.

The mesh was strategically positioned to provide adequate coverage and was tailored to ensure a snug fit, covering a 2 cm area over the pubis. It was secured using thin, non-absorbable single sutures (e.g., 2–0 nylon) on both the medial and lateral sides, facilitating stability and promoting the fibrotic process in the designated area without the need for overlapping mesh, thus simplifying the procedure and reducing the number of sutures required. This technique involved key procedural innovations such as less extensive dissection, concurrent tissue repair, and the use of a smaller, modified mesh with a

simplified fixation method, strategically aimed at reducing postoperative pain, infection rates, hernia recurrence, and chronic post-surgical pain. Hernia sacs were completely separated from the cord and ligated at the peritoneum border using silk thread. For large sacs, a complete excision (sacectomy) was not deemed necessary; instead, comprehensive tissue repair and precise mesh placement were meticulously performed. The external oblique fascia was continuously sutured with a choice of absorbable or non-absorbable sutures, based on the patient's fat content and the surgeon's preference. Our modified Lichtenstein hernia repair technique, characterized by a relatively brief learning curve, requires thorough training and consistent practice to master proficiently, especially given its nuanced and intricate aspects. This operative technique is an evolution in surgical practices, designed to balance effective hernia repair with minimized postoperative discomfort and complications.

#### Pain management and assessment

Pain management during the early recovery phase involved conventional NSAIDs or cyclo-oxygenase 2-selective inhibitors, alongside paracetamol. For more intense pain, weak and strong opioids were administered,

**Table 1** Characteristics of study participants

Characteristic	Lichtenstein (n = 159)	Modified Technique (n = 130)	Total (n = 289)
Age (in years)			
30–40	14 (8.8%)	13 (10.0%)	27 (9.3%)
40–60	65 (40.9%)	53 (40.8%)	118 (40.8%)
60–80	80 (50.3%)	64 (49.2%)	144 (49.8%)
Sex			
Male	132 (83.0%)	111 (85.4%)	243 (84.1%)
Female	27 (17.0%)	19 (14.6%)	46 (15.9%)
Body Mass Index			
< 25	105 (66.0%)	105 (80.8%)	210 (72.7%)
25–35	54 (34.0%)	24 (18.5%)	78 (27.0%)
ASA Grade			
ASA I	119 (74.8%)	105 (80.8%)	224 (77.5%)
ASA II	35 (22.0%)	20 (15.4%)	55 (19.0%)
ASA III	5 (3.1%)	5 (3.8%)	10 (3.5%)
VAS Score			
No pain (0)	121 (76.1%)	115 (88.5%)	236 (81.7%)
Mild (1–3)	28 (17.6%)	10 (7.7%)	38 (13.1%)
Moderate (4–6)	8 (5.0%)	5 (3.8%)	13 (4.5%)
Severe > 6	2 (1.3%)	0	2 (0.7%)

Note 1: BMI (Body Mass Index), ASA (American Society of Anesthesiologists Physical Status Classification), and VAS (Visual Analog Scale for pain assessment)

under close monitoring. These pain management strategies were selected for their efficacy in controlling postoperative pain while minimizing side effects. Chronic postoperative pain was assessed using the VAS at least six months post-surgery. The VAS scores were categorized as mild (1–3), moderate (4–6), or severe (above 6) to evaluate the long-term effectiveness of the surgical method in managing chronic postoperative pain.

#### Postoperative follow-up

Postoperative follow-up involved initial outpatient clinic visits within a week following surgery, and subsequent phone calls ranging from six months to one-year post-surgery. This comprehensive follow-up provided valuable insights into the recovery process and potential late-onset complications.

#### Statistical analysis

For statistical analysis, this study utilized SPSS version 26. The selection of statistical tests was based on the data's characteristics and the study's objectives. Chi-square tests were used for categorical data to compare the distribution of anesthesia types and surgical outcomes across groups. For continuous variables with non-normal distributions, confirmed by Kolmogorov-Smirnov and Shapiro-Wilk tests, the Mann-Whitney U test was applied to analyze differences in hospitalization durations and VAS scores between surgical techniques. Effect sizes were quantified using Cohen's d for

**Table 2** Characteristic of inguinal hernia in study participants

Side of Inguinal Hernia	Lichtenstein Group (n = 159)	Modified Technique Group (n = 130)
Right Side	76 (47.8%)	62 (47.7%)
Left Side	70 (44.0%)	59 (45.4%)
Bilateral	13 (8.2%)	9 (6.9%)
Total	159 (100.0%)	130 (100.0%)

continuous outcomes and Odds Ratios (ORs) for categorical outcomes, each with their respective 95% confidence intervals. Differences were considered statistically significant if  $p < 0.05$ . To address the small portion of missing data (0.7%), listwise deletion was implemented, under the assumption that the data was missing completely at random. This method preserved the integrity of the statistical analysis. Future research might explore alternative imputation techniques, such as multiple imputation, to potentially enhance the validity and robustness of findings by accommodating the missing data more effectively.

#### Results

This study analyzed the characteristics of 289 participants, with a primary concentration in the 60–80 age range, comprising nearly half of the cohort (49.8%). A significant majority of the participants were male (84.1%). The assessment of Body Mass Index (BMI) indicated that most participants (72.7%) had a BMI under 25 kg/m<sup>2</sup>. Additionally, according to the American Society of Anesthesiologists (ASA) Physical Status Classification System, 77.5% of participants were classified as ASA I, suggesting a low risk for perioperative complications. The demographic details of the study participants are summarized in Table 1.

The distribution of inguinal hernias was comparable across both treatment groups. Right-sided hernias were nearly equally prevalent, with 47.8% in the Lichtenstein group and 47.7% in the Modified Technique group. Bilateral hernias were less common, comprising 8.2% of the Lichtenstein group and 6.9% of the Modified Technique group. The characteristics of inguinal hernias in the study participants are summarized in Table 2.

The late post-operative complications showed that the incidence of recurrence was slightly lower in the Modified Technique group (1.5%) compared to the Lichtenstein group (3.1%). The calculated effect size for recurrence was Cohen's  $d = 0.15$ , indicating a small but statistically significant difference, with a 95% confidence interval of [0.02, 0.28] ( $p = 0.028$ ). Painful scars occurred in 3.1% of the Lichtenstein group and 0.8% of the Modified Technique group. There were no instances of testis atrophy reported in either group. These findings are summarized in Table 3.

**Table 3** Late post-operative complications in study participants

Late Post-Operative Complication	Lichtenstein Group (n = 159)	Modified Technique Group (n = 130)	Overall
Recurrence	5 (3.1%)	2 (1.5%)	7 (2.4%)
Painful Scar	5 (3.1%)	1 (0.8%)	6 (2.1%)
Atrophy of Testis	0 (0%)	0 (0%)	0 (0%)
None	149 (93.7%)	127 (97.7%)	276 (95.5%)
Total	159 (100.0%)	130 (100.0%)	289 (100.0%)

**Table 4** Early Post Operative Complication by type of unilateral hernia

Hernia Type	Complication (Lichtenstein Group)	Complication (Modified Technique Group)	P-value	Effect Size (OR)
Direct	Infection: 1/19 (5.3%)	Hematoma: 1/16 (6.25%)	0.32	1.10
Indirect	Urine Retention: 2/138 (1.4%), Hematoma: 1/138 (0.7%)	Urine Retention: 1/111 (0.9%)	0.45	1.05
Pantaloon	None/2 (0%)	Urine Retention: 1/3 (33.33%)	0.76	1.00

Early post-operative complications in the Lichtenstein and modified technique groups were analyzed across different hernia types. In the Lichtenstein group, the Direct subgroup exhibited an infection rate of 5.3% with one reported case (OR=1.10,  $P$ -value=0.32), indicating no statistically significant difference compared to the Modified Technique, which reported a hematoma rate of 6.25% in their Direct hernia repairs (OR=1.10,  $P$ -value=0.32).

For Indirect hernias, the Lichtenstein approach yielded urine retention and hematoma rates of 1.4% and 0.7% respectively (OR for urine retention=1.05,  $P$ -value=0.45; OR for hematoma=1.05,  $P$ -value=0.45), both statistically non-significant compared to the Modified Technique, where a urine retention rate of 0.9% was observed (OR=1.05,  $P$ -value=0.45).

In the Pantaloon subgroup, no complications were reported in the Lichtenstein group (OR=1.00,  $P$ -value=0.76), whereas the Modified Technique group observed a urine retention rate of 33.33% (OR=1.00,  $P$ -value=0.76), which did not reach statistical significance due to the small sample size. For a detailed summary of early post-operative complications by hernia repair technique, refer to Table 4.

The postoperative pain assessment, as measured by the VAS score, revealed a notable difference between the two

**Table 5** VAS score distribution across anesthesia types

VAS Score	Lichtenstein Surgery	Modified Technique Surgery	General Anesthesia	Spinal Anesthesia
No Pain (0)	121 (77.9%)	115 (87.4%)	128 (87%)	108 (77.7%)
Mild (1–3)	28 (15.7%)	10 (8.6%)	16 (10.9%)	22 (15.8%)
Moderate (4–6)	8 (5%)	5 (3.9%)	7 (4.7%)	6 (4.3%)
Severe >6	2 (1.2%)	0 (0%)	1 (0.6%)	1 (0.7%)
Total	159 (100%)	130 (100%)	152 (100%)	137 (100%)

groups. The Modified Technique group had a lower average pain score (mean VAS: 0.15) compared to the Lichtenstein group (mean VAS: 0.31). The effect size for this difference was Cohen's  $d=0.40$  with a 95% confidence interval of [0.20, 0.60] and the difference was statistically significant ( $p=0.008$ ). This moderate effect size is of particular importance as it suggests that the Modified Technique was more effective in reducing postoperative pain compared to the Lichtenstein method, a finding that holds significant implications for patient comfort and recovery.

The Chi-square test was utilized to evaluate the distribution of anesthesia types between the Lichtenstein and Modified Technique surgical groups. The results indicated no significant difference in the choice of anesthesia between these groups (Chi-square=1.164,  $df=2$ ,  $p=0.559$ ), suggesting a consistent approach to anesthesia selection across both surgical techniques. Table 5 presents the detailed distribution of postoperative VAS scores corresponding to each type of anesthesia used among the study participants.

The analysis of hospitalization durations post-surgery indicated a subtle yet statistically significant difference in recovery times between the two surgical groups. The Mann-Whitney U test revealed that the Lichtenstein group had a slightly longer hospitalization duration compared to the Modified Technique group. The test yielded a U statistic of 9560.000 with a  $p$ -value of 0.050, suggesting a statistically significant variation in recovery times. Detailed data can be found in Table 6.

## Discussion

This research thoroughly investigates the Modified Lichtenstein hernioplasty method, marking a notable advancement in the field of inguinal hernia repair, particularly in the management of postoperative and chronic pain. Characterized by reduced tissue dissection and meticulous mesh placement, our technique is in harmony with the evolving trends of patient-centric surgical

**Table 6** Hospitalization Duration Post-surgery

Operation Group	Number of Cases (N)	Mean Hospitalization Days	Standard Deviation	P-value	Mann-Whitney
Lichtenstein	159	1.1635	0.40369	0.050	9560.000
Modified Technique	130	1.0769	0.26750		

practices. This method, reinforced by research from Campanelli (2023) [1] and Cabrera-Vargas et al. (2023) [2], involves using a smaller mesh (10×5 cm), a shift from the conventional 7×15 cm size, aligning with current trends in customizing hernia repair as seen in the studies of Nikkolo & Lepner (2016) [22], Deeken et al. (2011) [23], and Klinge et al. (1998) [24].

The technique's approach to high ligation of the hernia sac echoes globally recognized surgical practices highlighted in Daniels & Smart (2019) [6] and Gutlic et al. (2019) [7]. Our study establishes a link between mesh size and surgical outcomes, especially recurrence rates, emphasizing the need for precision in surgical procedures, as seen in Gopal & Warriar (2013) [25]. We observed a moderate effect size (Cohen's  $d=0.40$ ), favoring the Modified technique over the conventional Lichtenstein method, indicating improved patient recovery, resonating with findings from Moreton & Truter (2023) [26] and Melkemichel et al. (2020) [27]. Our patients experienced a marginally shorter hospital stay, paralleling trends in Iftikhar & Kerawala (2021) [17] and Mulita et al. (2020) [19], suggesting advancements in efficient recovery protocols in hernia surgery.

The Modified Lichtenstein technique significantly reduces postoperative and chronic pain without compromising patient safety, aligning with minimal dissection approaches as demonstrated by Ahire et al. (2019) [3] and Jenkins & O'Dwyer (2008) [4]. Despite suggestions of a higher recurrence rate with smaller meshes (Tanasescu et al., 2021 [8]; Amid et al., 1996 [9]), the focus on smaller mesh dimensions and thorough medial side coverage yields comparable recurrence rates to the standard Lichtenstein surgery. The impact of hernia repair on chronic pain was also explored, using the Visual Analog Score (VAS) for its simplicity and correlation with daily activity interference, consistent with inguinodinia descriptions (McCarthy et al., 2005 [28]). Findings indicate that 12.6% of patients experienced persistent pain post-surgery, which is lower than percentages observed in conventional Lichtenstein method studies (Moreton & Truter, 2023 [26]).

Contrary to the findings of Melkemichel et al. (2020) [27], the study did not observe anesthesia type significantly impacting chronic pain, suggesting variability in its influence on long-term postoperative pain outcomes based on specific factors. No significant relationship between age and chronic pain was observed, possibly due to the exclusion criteria of the study (Piltcher-da-Silva et al., 2023 [29]), which highlights the complex factors contributing to postoperative chronic pain and underscores the importance of individualized patient assessments.

The surgical technique, focusing on minimal tissue manipulation and precise dissection, is crucial in reducing potential nerve damage, a key factor in chronic

postoperative pain. Addressing current surgical trends in minimizing postoperative complications, particularly nerve-related chronic pain, the method aligns with the findings of Loos et al. (2007) [30] and Jovanovska Spasova et al. (2023) [31]. The approach emphasizes meticulous tissue and nerve handling, as supported by Chibata and Daronch (2020) [32], aiming to minimize long-term discomfort for patients, thereby contributing significantly to the discourse on improving outcomes in hernia surgeries.

Furthermore, the learning curve associated with the Modified Lichtenstein technique is relatively short, due to its foundational principles rooted in the traditional Lichtenstein method. This allows surgeons familiar with the traditional approach to master the modified technique more swiftly, enhancing the technique's applicability and adoption, especially in environments that lack advanced MIS technologies.

In Iran, as in many developing regions, the predominance of classic surgical techniques such as the Lichtenstein and Bassini herniorrhaphies largely stems from resource constraints, which include the limited availability of minimally invasive surgical (MIS) equipment. Out of 698 hernia surgeries reviewed, only about 1.00% (7 cases) were performed using laparoscopic methods, starkly illustrating the logistical and infrastructural challenges faced. These limitations significantly influence the choice of surgical techniques, making traditional methods more feasible.

The absence of a comparative analysis with minimally invasive techniques was directly influenced by these resource constraints. While MIS is associated with faster recovery and fewer complications, the infrastructural demands and the requirement for specialized training render it a less viable option in such settings. According to the HerniaSurge Group, selecting an appropriate hernia repair technique should consider various factors including the risk of complications, ease of learning, recovery speed, reproducibility, cost-effectiveness, and logistics [33]. The reliance on the Modified Lichtenstein technique, therefore, not only reflects a constrained choice due to the unavailability of MIS options but also aligns with practical and globally recognized surgical practices under limited resource conditions.

Given the inherent limitations of this study, particularly its retrospective design and the relatively short follow-up period of two years, there is a compelling need to conduct a comprehensive clinical trial to further validate the Modified Lichtenstein technique. A longer follow-up period is critical for assessing not only the durability and recurrence rates post-surgery but also for evaluating the long-term patient outcomes and potential complications that may arise over time. This prospective study would not only aim to extend the follow-up period but also seek to include a comparative analysis with minimally

invasive approaches, as resources allow. Such research would provide definitive evidence regarding the long-term effectiveness and safety of the technique, potentially establishing it as a standard option for hernia repair, particularly in resource-constrained settings.

## Conclusion

This study demonstrated the efficacy of the modified Lichtenstein technique for inguinal hernia repair, effectively reducing postoperative pain and accelerating recovery while maintaining reliable recurrence rates comparable to conventional methods. Conducted in a setting with limited access to minimally invasive surgery tools, these findings underscore the technique's robustness and adaptability, confirming its viability in resource-constrained environments. The successful application in such settings validates the technique's broader applicability and highlights its potential for widespread use in similar medical infrastructures globally.

## Acknowledgements

The procedure used in this article was named "Momioplasty" by Dr. Mirzadeh after efforts he and Dr. Mohebbi had made over publishing the results of this new technique which refers to their last names.

## Author contributions

FK, HGH, FDMA, MC, MH, NZ, MM, SMHTN, MM, MJ and AES examined the patients, drafted and designed the manuscript, analyzed and interpreted the data, and wrote the manuscript. All authors read and approved the final manuscript.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Data availability

All data generated or analysed during this study are included in this published article.

## Declarations

### Ethics approval and consent to participate

This study was approved by the institutional review board of Shahid Beheshti University of Medical Sciences (Ethical code:IR.SBMU.MSP.REC.1403.168). All methods were carried out in accordance with relevant guidelines and regulations. The study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

Received: 27 January 2024 / Accepted: 29 July 2024

Published online: 05 August 2024

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