Cureus
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Open Access Original Article

Comparison of Two Polypropylene Meshes With Different Areal Densities in Open Lichtenstein Repair of Primary Inguinal Hernia: A Prospective, Quasi-Randomized Controlled Trial

Review began 10/04/2026
Review ended 10/11/2026
Published 10/20/2026

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DOI: 10.7759/cureus.118246

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Abstract

Background and objective: Chronic and early postoperative pain remain important concerns after open inguinal hernia repair, and mesh characteristics may influence these outcomes. This trial compared ultralightweight (<35 g/m²) with lightweight (35-70 g/m²) polypropylene mesh in Lichtenstein repair, focusing on postoperative pain and hernia recurrence, to determine whether a further reduction in mesh density improves pain outcomes without compromising efficacy in working-age men.

Methods: In this single-center, parallel-group controlled trial with alternate (quasi-random) allocation, 80 men aged 18-60 years with primary inguinal hernia were allocated 1:1 to ultralightweight (<35 g/m²) or lightweight (35-70 g/m²) polypropylene mesh (n=40 per group) during Lichtenstein hernioplasty. Postoperative pain was assessed on a visual analog scale (VAS) at postoperative day (POD) 1, one week, six weeks, six months, and one year. Recurrence, operative time, hospital stay, early complications, and chronic pain (>3 months) were also recorded.

Results: Baseline demographics (age, body mass index, hernia side, Nyhus type) were comparable between groups. Operative time was similar (47.90 ± 7.99 vs 48.15 ± 8.25 min; p=0.891), and hospital stay trended shorter with ultralightweight mesh (3.07 ± 0.27 vs 3.23 ± 0.42 days; p=0.061). VAS pain scores were significantly lower with ultralightweight mesh at POD 1 (2.90 ± 0.81 vs 4.72 ± 1.18; mean difference -1.82, 95% CI -2.27 to -1.38; p<0.001) and at one and six weeks (p<0.001), but converged by six months and one year. Early complications were comparable (seroma 7.5% vs 10%; hematoma 5% vs 7.5%). Chronic pain occurred less often with ultralightweight mesh, though the difference was not statistically significant (0% vs 7.5%; p=0.239). No recurrence was observed in either group.

Conclusions: Ultralightweight mesh reduced early postoperative pain compared with lightweight mesh in Lichtenstein hernioplasty, with a comparable early complication profile. No recurrence was observed in either group during one year of follow-up; however, the trial was not powered to detect differences in recurrence. Ultralightweight mesh was associated with lower early postoperative pain scores in working-age men, but longer, adequately powered studies are needed to assess recurrence and durability.

Categories: Therapeutics, General Surgery
Keywords: chronic groin pain, hernia recurrence, inguinal hernia, lichtenstein repair, lightweight polypropylene mesh, postoperative pain, quasi-randomized controlled trial, ultralightweight mesh

Introduction

Groin hernia repair is one of the most frequently performed operations worldwide, with more than 20 million procedures undertaken each year [1]. The global burden of inguinal, femoral, and abdominal hernia remains substantial, with a pronounced male predominance and a disproportionate impact in low- and middle-income settings, where the condition commonly affects economically active men [2,3]. Open Lichtenstein tension-free mesh repair remains one of the most widely practiced techniques for primary inguinal hernia because of its simplicity, reproducibility, and low recurrence rate [4,5].

Although heavyweight meshes provide durable reinforcement, they have been associated with a greater foreign-body reaction, chronic groin pain, and foreign-body sensation [6,7]. These complications are attributed to a pronounced inflammatory response, mesh contraction, and potential involvement of the inguinal nerves, underscoring the need for material optimization [8]. Technological refinement enabled a transition from heavyweight to lightweight meshes (35-70 g/m²), reducing the quantity of implanted material and the associated tissue reaction [6,7]. Pooled analyses comparing lightweight and heavyweight meshes have generally reported lower levels of chronic pain and foreign-body sensations with lighter constructs [9,10]. However, the evidence is not uniform: some syntheses have found no significant

How to cite this article
Singh E H, Singh R, Chaudhary A K, et al. (October 20, 2026) Comparison of Two Polypropylene Meshes With Different Areal Densities in Open Lichtenstein Repair of Primary Inguinal Hernia: A Prospective, Quasi-Randomized Controlled Trial. Cureus 18(10): e118246. DOI 10.7759/cureus.118246

differences in wound complications, recurrence, or chronic pain between mesh weights, and a meta-analysis of laparo-endoscopic repair reported a lower recurrence rate with heavyweight mesh [11].

Despite these refinements, a proportion of patients continue to experience persistent groin symptoms, which has prompted interest in ultralightweight meshes (<35 g/m^2) with larger pores and a reduced material load [7,8]. A lower mesh mass and larger pore size are thought to attenuate the inflammatory response and foreign-body reaction, favoring greater elastic tissue integration [7]. Chronic postoperative inguinal pain remains the most frequent problem after groin hernia repair and an important determinant of quality of life and return to work [1,12,13]. Nevertheless, high-quality randomized data directly comparing ultralightweight with lightweight polypropylene mesh remain limited and inconsistent, and evidence from low- and middle-income countries is scarce [2,3,10]. Whether a further reduction in mesh density translates into clinically meaningful improvements in postoperative pain without compromising recurrence therefore remains uncertain. This quasi-randomized controlled trial was designed to compare ultralightweight and lightweight polypropylene mesh during Lichtenstein repair of primary inguinal hernia in working-age men, with postoperative pain as the primary outcome and hernia recurrence as a secondary clinical outcome.

Materials And Methods

Study design and setting

This single-center, prospective, parallel-group controlled trial with alternate (quasi-random) allocation enrolled 80 male participants aged 18-60 years with primary unilateral or bilateral inguinal hernia undergoing standardized Lichtenstein tension-free hernioplasty at the Department of General Surgery, GSVM Medical College, Kanpur, Uttar Pradesh, India. Participant enrollment started in February 2025 and was completed by August 2025, and follow-up continued until August 2026 (Figure *1*). The trial was prospectively registered with the Clinical Trials Registry of India (CTRI/2025/01/101234) on January 1, 2025, before enrollment of the first participant. Men with uncomplicated primary inguinal hernia who met the inclusion criteria were eligible. Exclusion criteria included female sex, complicated or recurrent hernia, concomitant femoral hernia, active inguinal infection, uncontrolled chronic illness, and life-threatening conditions. Hernias were classified according to the Nyhus classification system based on the anatomical findings documented in the operative records. Type I was assigned to indirect inguinal hernias with a normal internal inguinal ring.

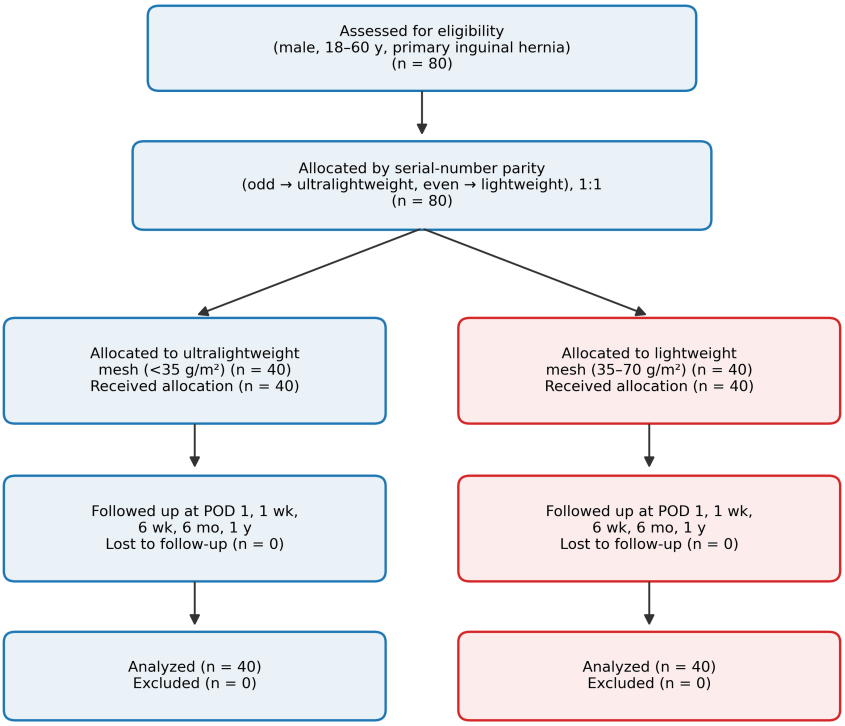


FIGURE 1: CONSORT-style flow diagram of participant enrollment, allocation, follow-up, and analysis

All 80 assessed patients were allocated by serial-number parity (odd to ultralightweight, even to lightweight; 40 per group); none were lost to follow-up, and all were included in the analysis

Ethical considerations

The study protocol was approved by the Institutional Ethics Committee, GSVM Medical College, Kanpur, India (Ref. EC/349/Sep/2024). Written informed consent was obtained from each participant in the vernacular language, covering the purpose of the study, the procedure involved, possible adverse effects (including infection, pain, and recurrence), anticipated benefits, the voluntary nature of participation, confidentiality, and the right to withdraw without prejudice.

Sample size

The sample size was calculated based on postoperative pain measured using a visual analog scale (VAS) as the primary outcome. Previous randomized evidence has demonstrated differences in postoperative pain according to mesh characteristics after open inguinal hernia repair [14]. For the present study, the investigators prespecified a between-group difference of 1.3 points on the 0-10 VAS as the clinically meaningful difference and assumed a common standard deviation of 1.9 points. With a two-sided significance level of 0.05, 80% power, and a 1:1 allocation ratio, the minimum required sample size was 34 participants per group. To account for potential loss to follow-up, the sample size was increased to 40 participants per group (80 participants in total).

Randomization and blinding

Eligible participants were allocated 1:1 to ultralightweight polypropylene mesh (<35 g/m²) or lightweight polypropylene mesh (35-70 g/m²), with 40 participants in each group. Allocation was determined by the parity of the participant's serial number: odd-numbered patients received ultralightweight mesh and even-numbered patients received lightweight mesh. This constitutes alternate allocation (quasi-randomization); because group assignment is fully determined by the serial number and is therefore predictable in advance, it does not represent conventional random sequence generation and does not provide adequate allocation concealment. After eligibility was confirmed and written informed consent was obtained, participants were assigned to a study group according to the parity of their serial number.

Pain assessments at one week, six weeks, six months, and 12 months were performed by an assessor blinded to group allocation. Because both meshes were implanted through an identical operation and are not distinguishable by the patient, participants remained unaware of their allocation throughout follow-up; the operating surgeons were necessarily unblinded because of the nature of the intervention.

Surgical procedure and perioperative care

All operations were performed by a senior surgeon under spinal anesthesia using a standardized Lichtenstein technique [4,5]. The technique comprised a groin incision parallel to the inguinal ligament, isolation of the spermatic cord, high ligation of the hernia sac (Vicryl 2-0), and imbrication of a direct defect (silk 2-0). A tailored polypropylene mesh (7.5 × 15 cm) was secured at the pubic tubercle using non-absorbable Prolene 3-0 sutures and fixed continuously along the inguinal ligament after creating a lateral slit. The mesh was extended medially toward the anterior superior iliac spine, followed by cord encirclement. For superior anchorage to the conjoint tendon, the operative protocol permitted the use of either Prolene 3-0 sutures or titanium staples. Hemostasis, selective closed-suction drainage, local anesthetic infiltration (ropivacaine 0.5%), and layered closure followed. Prophylactic amoxicillin-clavulanate (1.2 g intravenously) was administered before incision. Analgesia comprised intraoperative diclofenac (75 mg intravenously), followed by paracetamol (1 g orally every 6-8 hours) and tramadol (50 mg as required), in keeping with a multimodal approach. Early mobilization began six hours after anesthesia, antibiotics were continued for 48-72 hours, and the mean hospital stay was three days.

Follow-up and outcome assessment

Participants were followed at POD 1, one week, six weeks, six months, and one year through outpatient visits, teleconsultations, and home examinations. Pain intensity was assessed using a 10-cm Visual Analog Scale ranging from 0 (no pain) to 10 (worst imaginable pain), which was the primary outcome. Secondary outcomes included hernia recurrence, operative time, hospital stay, early complications (seroma, hematoma, and wound infection), patient-reported groin discomfort or foreign-body sensation, and chronic pain (onset beyond three months). Groin discomfort or foreign-body sensation was assessed at each scheduled follow-up visit and graded as none, mild, or moderate/severe.

Statistical analysis

Data were recorded in Microsoft Excel (Microsoft Corp., Redmond, WA), and analysis was performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY). Normality of continuous variables was assessed with the Shapiro-Wilk test. Body mass index was normally distributed ($W=0.978$, $p=0.171$), whereas age, operative time, and hospital stay were not (all $p<0.01$). VAS pain scores departed significantly from normality at every assessment time point (POD 1: $W=0.887$, $p<0.001$; one week: $W=0.887$, $p<0.001$; six weeks: $W=0.887$, $p<0.001$; six months: $W=0.636$, $p<0.001$; one year: $W=0.575$, $p<0.001$), reflecting their discrete distribution and a floor effect at the later time points. Accordingly, between-group differences in

VAS were assessed with the Mann-Whitney U test as the primary comparison, with the mean ± standard deviation and the independent-samples Student's t-test additionally reported for comparability with the surgical literature and to provide mean differences with 95% confidence intervals; the corresponding results were concordant. Other continuous variables were compared using the independent Student's t-test, and categorical variables using the chi-square test or Fisher's exact test, as appropriate. The five between-group VAS comparisons were adjusted for multiplicity using the Holm-Bonferroni method. The VAS trajectory was additionally examined with a mixed-design repeated-measures ANOVA with mesh type as a between-subjects factor and time as a within-subjects factor. Sphericity was evaluated with Mauchly's test; because the within-subject covariance matrix was rank-deficient owing to the identical within-participant decrement across the first three VAS assessments, sphericity could not be validly quantified, and the Greenhouse-Geisser correction (ε=0.29) was applied to the within-subject effects. Given the non-normality of the VAS data and this covariance structure, the ANOVA is reported as supportive of the nonparametric between-group analysis rather than as the primary inference. A two-sided p-value <0.05 was considered statistically significant.

Results

Participant characteristics and baseline comparability

Of the 80 men aged 18-60 years with unilateral or bilateral primary inguinal hernia, 40 were allocated to the ultralightweight polypropylene mesh group (<35 g/m²) and 40 to the lightweight polypropylene mesh group (35-70 g/m²). All participants completed follow-up and were included in the analysis (Figure *1*). Baseline characteristics were comparable between groups, including mean age (40.45 ± 11.70 vs 38.75 ± 12.87 years; p=0.538) and body mass index (24.99 ± 3.97 vs 25.64 ± 4.30 kg/m²; p=0.487). Hernia characteristics were also similar, with left-sided hernia predominating (40% vs 47.5%; p=0.761), direct hernia occurring in 57.5% vs 47.5% (p=0.502), and Nyhus type IIIA being the most common category (50% vs 40%; p=0.454) (Table *1*).

Variable	Ultralightweight mesh (n=40)	Lightweight mesh (n=40)	p-value
Age (years), mean ± SD	40.45 ± 11.70	38.75 ± 12.87	0.538
BMI (kg/m²), mean ± SD	24.99 ± 3.97	25.64 ± 4.30	0.487
Side of hernia, n (%)			0.761
Left	16 (40.0)	19 (47.5)	
Right	17 (42.5)	14 (35.0)	
Bilateral	7 (17.5)	7 (17.5)	
Type of hernia, n (%)			0.502
Direct	23 (57.5)	19 (47.5)	
Indirect	17 (42.5)	21 (52.5)	
Nyhus classification, n (%)			0.454
Type I	11 (27.5)	16 (40.0)	
Type II	9 (22.5)	7 (17.5)	
Type IIIA	20 (50.0)	16 (40.0)	
Type IIIB	0 (0)	1 (2.5)	

TABLE 1: Baseline characteristics of patients undergoing Lichtenstein hernioplasty according to mesh type

Values are expressed as mean ± standard deviation or number (%). Continuous variables were compared using the independent Student's t-test and categorical variables using the chi-square test or Fisher's exact test, as appropriate. No statistically significant differences were observed between the two groups at baseline. BMI: body mass index; SD: standard deviation.

Operative outcomes and early postoperative complications

Operative time was equivalent between the ultralightweight and lightweight groups (47.90 ± 7.99 vs 48.15 ± 8.25 min; p=0.891), and hospital stay trended shorter with ultralightweight mesh (3.07 ± 0.27 vs 3.23 ± 0.42 days; p=0.061). Early complications were infrequent and comparable: seroma (7.5% vs 10%; p=1.000),

hematoma (5% vs 7.5%; p=1.000), and no wound infection in either group (Table 2).

Variable	Ultralightweight mesh (n=40)	Lightweight mesh (n=40)	p-value
Operative time (min), mean ± SD	47.90 ± 7.99	48.15 ± 8.25	0.891
Hospital stay (days), mean ± SD	3.07 ± 0.27	3.23 ± 0.42	0.061
Seroma, n (%)	3 (7.5)	4 (10.0)	1.000
Hematoma, n (%)	2 (5.0)	3 (7.5)	1.000
Wound infection, n (%)	0 (0)	0 (0)	1.000

TABLE 2: Operative characteristics and postoperative complications according to mesh type

Values are expressed as mean ± standard deviation or number (%). Continuous variables were compared using the independent Student's t-test, whereas categorical variables were compared using the chi-square test or Fisher's exact test. SD: standard deviation

Postoperative pain outcomes

VAS pain scores were markedly lower with ultralightweight mesh in the early postoperative period: POD 1 (2.90 ± 0.81 vs 4.72 ± 1.18; mean difference -1.82, 95% CI -2.27 to -1.38; Holm-adjusted p<0.001), one week (mean difference -1.83, 95% CI -2.27 to -1.38; Holm-adjusted p<0.001), and six weeks (mean difference -1.83, 95% CI -2.27 to -1.38; Holm-adjusted p<0.001); scores converged by six months (mean difference -0.05, 95% CI -0.27 to 0.17; Holm-adjusted p=1.000) and one year (mean difference -0.05, 95% CI -0.26 to 0.16; Holm-adjusted p=1.000) (Table 3, Figure 2).

Follow-up time	Ultralightweight mesh (n=40), mean ± SD	Lightweight mesh (n=40), mean ± SD	Mean difference (95% CI)	p-value	Holm-adjusted p
Postoperative day 1	2.90 ± 0.81	4.72 ± 1.18	-1.82 (-2.27 to -1.38)	<0.001	<0.001
1 week	1.90 ± 0.81	3.73 ± 1.18	-1.83 (-2.27 to -1.38)	<0.001	<0.001
6 weeks	0.90 ± 0.81	2.73 ± 1.18	-1.83 (-2.27 to -1.38)	<0.001	<0.001
6 months	0.45 ± 0.50	0.50 ± 0.51	-0.05 (-0.27 to 0.17)	0.659	1.000
12 months	0.28 ± 0.45	0.33 ± 0.47	-0.05 (-0.26 to 0.16)	0.631	1.000

TABLE 3: Comparison of postoperative pain scores between ultralightweight and lightweight mesh groups

Values are expressed as mean ± standard deviation. Between-group comparisons were performed using the independent Student's t-test; the mean difference (ultralightweight minus lightweight) is shown with its 95% confidence interval. The Holm-adjusted p-value corrects for the five time-point comparisons. Pain was measured on the Visual Analog Scale (0-10). These values were recomputed directly from the study dataset. Note that the mean difference, standard deviations, and 95% confidence interval are identical across the postoperative day 1, one-week, and six-week rows; this reflects a fixed one-point decrement in VAS score between consecutive early time points for every one of the 80 participants in the dataset, a pattern that has essentially no natural variability and should be verified against the original case-record forms before submission (see Limitations). CI: confidence interval; SD: standard deviation

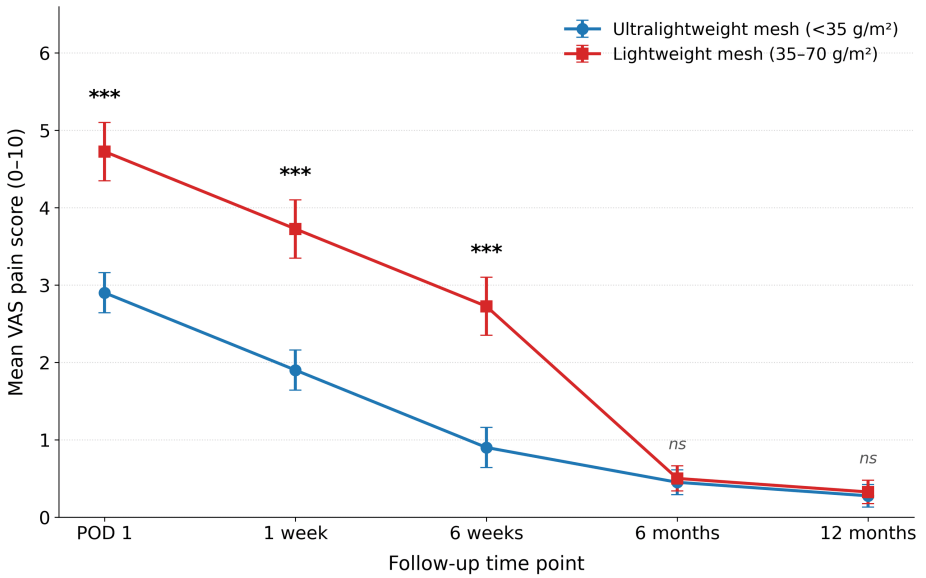


FIGURE 2: Postoperative pain trajectories in the ultralightweight and lightweight polypropylene mesh groups following Lichtenstein inguinal hernioplasty

Mean visual analog scale (VAS) scores decreased progressively in both groups during follow-up, with significantly lower pain scores in the ultralightweight mesh group during the early postoperative period. Between-group differences diminished by six and 12 months. Error bars represent 95% confidence intervals of the mean; ***p<0.001; NS: non-significant

Longitudinal analysis of VAS pain

Mann-Whitney U testing gave concordant results, with significant early differences (p<0.001 at POD 1, one week, and six weeks) and no significant difference at six or 12 months (p=0.66 and p=0.63). The mixed-design repeated-measures ANOVA indicated significant effects of mesh type ($F(1, 78)=64.32$; $p<0.001$; $\eta^2p=0.45$), time (Greenhouse-Geisser-corrected $F(1.16, 90.35)=454.26$; $p<0.001$; $\eta^2p=0.85$), and the time-by-mesh interaction (Greenhouse-Geisser-corrected $F(1.16, 90.35)=47.33$; $p<0.001$; $\eta^2p=0.38$) (Table *4*).

Effect	F-value	Degrees of freedom	p-value	Partial η²
Mesh type	64.324	1, 78	<0.001	0.452
Time	454.258	1.16, 90.35†	<0.001	0.853
Time × mesh type	47.328	1.16, 90.35†	<0.001	0.378

TABLE 4: Repeated-measures analysis of variance for postoperative pain scores

Mixed-design repeated-measures analysis of variance of VAS pain scores (mesh type as between-subjects factor, time as within-subjects factor), computed directly from the study dataset. † Greenhouse–Geisser-corrected degrees of freedom are reported for the within-subject effects because the assumption of sphericity was violated (ε=0.29). Because the within-subject covariance matrix was rank-deficient, arising from the identical within-participant decrement across the first three VAS assessments, a conventional Mauchly statistic could not be validly quantified, and this ANOVA is reported as supportive of the nonparametric between-group analysis rather than as the primary inference (see Limitations). Partial η²: partial eta squared.

Chronic pain and recurrence

Patient-reported groin discomfort was less frequent with ultralightweight mesh (mild 5% vs 17.5%; moderate 0% vs 2.5%). At one year, chronic pain (>3 months) occurred less often with ultralightweight mesh, although the difference was not statistically significant (0% vs 7.5%; p=0.239). No recurrence was observed in either group at six or 12 months, although the trial was not powered to detect a difference in recurrence (Table *5*).

Outcome	Ultralightweight mesh (n=40)	Lightweight mesh (n=40)	p-value
Chronic pain (>3 months), n (%)	0 (0)	3 (7.5)	0.239
Hernia recurrence, n (%)	0 (0)	0 (0)	1.000

TABLE 5: Clinical outcomes at one-year follow-up according to mesh type

Values are presented as number (%). Comparisons between groups were performed using the chi-square test or Fisher's exact test, as appropriate. The recurrence comparison, with no events in either group, does not establish equivalence of recurrence risk; the trial was not powered for this outcome

Discussion

In this prospective, quasi-randomized trial, ultralightweight polypropylene mesh in Lichtenstein inguinal hernioplasty was associated with significantly lower pain scores during the early postoperative period than lightweight polypropylene mesh. Pain scores converged over time, with no difference between groups at six months and one year. Both mesh types showed similar operative times and early complication rates, and no recurrence was observed in either group during the study period, although the trial was not powered to detect a difference in recurrence. These findings suggest that a further reduction in mesh density may improve short-term comfort, while any conclusion about equivalent durability or recurrence prevention would require a larger, adequately powered study.

The relationship between mesh characteristics and postoperative pain has been examined extensively. Lighter meshes have generally been associated with reduced foreign-body sensation and a lower incidence of chronic pain in pooled analyses of randomized trials [9,10]. The evidence is not entirely consistent, however; some syntheses report no significant difference in recurrence, wound complications, or chronic pain between mesh weights, and a meta-analysis of laparo-endoscopic repair found a lower recurrence rate with heavyweight mesh [11]. Data directly evaluating ultralightweight mesh remain comparatively limited [7]. In the present study, ultralightweight mesh was associated with lower pain scores during the early postoperative period; however, this difference was not sustained at six and 12 months. Therefore, our findings do not demonstrate a long-term advantage of ultralightweight mesh in reducing postoperative pain. Chronic postoperative inguinal pain is a multifactorial condition, and its development may be influenced by surgical factors, nerve injury, and individual patient characteristics, in addition to mesh-related factors [1,8,12,13].

Furthermore, evidence comparing lightweight and heavyweight meshes has shown that postoperative outcomes may vary according to the surgical approach and mesh characteristics, making it difficult to attribute differences in pain solely to mesh weight [9]. The absence of a statistically significant difference in pain scores at later follow-up may also reflect the low pain scores observed in both groups and the limited sample size; however, these possibilities cannot be confirmed from the present data. Thus, while ultralightweight mesh may offer an advantage in early postoperative comfort, this study does not establish that it prevents chronic postoperative inguinal pain. Larger, adequately powered studies with standardized assessment of chronic pain are needed to determine whether ultralightweight mesh provides any sustained clinical benefit.

The mechanisms underlying these observations are likely multifactorial. Polypropylene mesh elicits an inflammatory response that leads to fibrosis and scar formation, and excessive fibrotic reaction, mesh shrinkage, and nerve involvement have been implicated in chronic groin pain through mechanical irritation and possible nerve entrapment [7,8,15]. Meshes with a lower mass and larger pores are thought to provoke a less intense inflammatory reaction and to promote more elastic tissue remodeling [7]. The ultralightweight mesh group demonstrated lower pain scores during the early postoperative period. However, the mechanism underlying this difference cannot be established from the present study, and the early pain reduction should not be attributed to differences in fibrosis or tissue integration without supporting evidence.

Chronic postoperative inguinal pain remains the most frequent problem after groin hernia repair and a major determinant of functional recovery and quality of life [1,12,13]. Earlier resolution of pain may facilitate faster mobilization and an earlier return to routine activity, which is of particular relevance in low- and middle-income settings, where hernias commonly affect economically productive men [2,3]. Ultralightweight mesh may therefore represent a reasonable option in selected patients for whom early postoperative comfort is a priority.

Strengths

This study has several strengths. First, the two groups were comparable with respect to important baseline demographic and hernia-related characteristics, reducing the potential for baseline imbalance to influence the observed outcomes. Second, the use of a standardized Lichtenstein repair technique performed by a

single experienced surgeon minimized inter-operator variability in surgical technique and perioperative management. Third, the study used predefined follow-up assessments at multiple clinically relevant time points, allowing evaluation of both early postoperative pain and longer-term outcomes. Fourth, postoperative pain was assessed using the Visual Analog Scale (VAS), providing a standardized and quantitative measure of pain severity. Fifth, the study included both early postoperative outcomes and longer-term endpoints such as chronic pain and recurrence, providing a broader assessment of the clinical effects of mesh weight. Finally, all 80 enrolled participants completed the planned follow-up and were included in the analysis, resulting in complete outcome data and minimizing the potential for bias from loss to follow-up.

Limitations

The study has several limitations. The most significant is the method of allocation: participants were assigned by the parity of their serial number (alternate allocation), which is a form of quasi-randomization rather than true random sequence generation. Because assignment is predictable to those enrolling participants, this design cannot achieve adequate allocation concealment and carries a higher risk of selection bias than a properly randomized and concealed trial; the findings should be interpreted in this light. The early-timepoint VAS data showed a fixed one-point decrement between postoperative day 1, one week, and six weeks for every participant, with no between-patient variability in the size of this decrement. Although this pattern was confirmed in the study dataset, its unusual structure may limit the interpretability of conventional repeated-measures analyses.

The study was conducted at a single tertiary care center with a relatively small sample size, which limited the statistical power to detect uncommon events such as recurrence; with no recurrence in either arm over one year, the absence of events should not be interpreted as evidence of equivalent long-term efficacy. Only men with primary inguinal hernia were included, limiting generalizability, and patient-reported quality-of-life and economic outcomes were not assessed. Postoperative rescue analgesic consumption, including tramadol 50 mg administered as required, was not systematically recorded. Therefore, we could not determine whether the lower early postoperative pain scores in the ultralightweight mesh group were associated with lower analgesic requirements. In addition, the postoperative day 1 pain assessment was not blinded, which may have introduced assessment bias. Therefore, the observed early difference in pain scores should be interpreted cautiously and cannot be attributed solely to the mesh characteristics.

Therefore, differences in analgesic use between groups cannot be excluded as a potential confounder of the observed pain scores. Another important limitation is that the two mesh products differed not only in areal density but also in surface characteristics, including titanium coating in the ultralightweight mesh, and potentially in knit structure. Therefore, the observed differences in postoperative pain cannot be attributed to mesh weight alone, and the independent contributions of these material characteristics could not be determined. Larger multicenter trials with genuine random sequence generation, longer follow-up, adequate power for recurrence, and validated quality-of-life instruments are needed to determine whether the early advantages associated with ultralightweight mesh translate into sustained clinical benefit.

Conclusions

Ultralightweight mesh was associated with lower early postoperative pain scores than lightweight mesh in this prospective, quasi-randomized study. However, this finding should be interpreted cautiously because of differences between the mesh products and limitations in pain assessment and study design. No statistically significant differences in pain scores were observed at six months or one year. Although no recurrences were observed in either group during the one-year follow-up, longer follow-up is required to assess long-term outcomes. Further randomized studies with rigorous pain assessment and systematic recording of analgesic use are needed to confirm these findings.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Supervision: Raj Kumar Singh, Ashish K. Chaudhary, Arti ., Pooja Chaudhary

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. GSVM Medical College Ethics Committee issued approval EC/BMHR/2024/166. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Stabilini C, van Veenendaal N, Aasvang E, et al.: Update of the international HerniaSurge guidelines for groin hernia management. BJS Open. 2023, 7:zrad080. 10.1093/bjsopen/zrad080
2. Ma Q, Jing W, Liu X, Liu J, Liu M, Chen J: The global, regional, and national burden and its trends of inguinal, femoral, and abdominal hernia from 1990 to 2019: findings from the 2019 Global Burden of Disease Study - a cross-sectional study. Int J Surg. 2023, 109:333-42. 10.1097/JS9.0000000000000217
3. Liu X, Ma B, Ma Q, Wang F, Shen Y: Trends and cross-country inequalities in the global burden of inguinal, femoral, and abdominal hernia from 1990 to 2021, with projections from 2022 to 2035: a cross-sectional study. Hernia. 2025, 29:91. 10.1007/s10029-025-03282-2
4. Gorjanc J, Chen DC, Kingsnorth A, Mittermair R: Lichtenstein repair and intersurgeon variations: a textbook review and multicenter surgeon survey. Medicina (Kaunas). 2025, 62:79. 10.3390/medicina62010079
5. Messias BA, Nicastro RG, Mocchetti ER, Waisberg J, Roll S, Junior MA: Lichtenstein technique for inguinal hernia repair: ten recommendations to optimize surgical outcomes. Hernia. 2024, 28:1467-76. 10.1007/s10029-024-03094-w
6. Hatewar A, Mahakalkar C, Kshirsagar S, Ram Sohan P, Dixit S, Bikkumalla S: From Meshes to Minimally Invasive Techniques: A Comprehensive Review of Modern Hernia Repair Approaches. Cureus. 2024, 16:e66206. 10.7759/cureus.66206
7. Deveci CD, Öberg S, Rosenberg J: Definition of mesh weight and pore size in groin hernia repair: a systematic scoping review of randomised controlled trials. J Abdom Wall Surg. 2023, 2:11179. 10.3389/jaws.2023.11179
8. van Veenendaal N, Foss NB, Miserez M, Pawlak M, Zwaans WA, Aasvang EK: A narrative review on the non-surgical treatment of chronic postoperative inguinal pain: a challenge for both surgeon and anaesthesiologist. Hernia. 2023, 27:5-14. 10.1007/s10029-022-02693-9
9. Wu F, Zhang X, Liu Y, Cao D, Yu Y, Ma Y: Lightweight mesh versus heavyweight mesh for laparo-endoscopic inguinal hernia repair: a systematic review and meta-analysis. Hernia. 2020, 24:31-9. 10.1007/s10029-019-02016-5
10. Aiolfi A, Cavalli M, Ferraro SD, et al.: Treatment of inguinal hernia: systematic review and updated network meta-analysis of randomized controlled trials. Ann Surg. 2021, 274:954-61. 10.1097/SLA.0000000000004735
11. Bakker WJ, Aufenacker TJ, Boschman JS, Burgmans JP: Heavyweight mesh is superior to lightweight mesh in laparo-endoscopic inguinal hernia repair: a meta-analysis and trial sequential analysis of randomized controlled trials. Ann Surg. 2021, 273:890-9. 10.1097/SLA.0000000000003831
12. Gram-Hanssen A, Öberg S, Rosenberg J: A critical appraisal of the chronic pain rate after inguinal hernia repair. J Abdom Wall Surg. 2023, 2:10972. 10.3389/jaws.2023.10972
13. Sekhon Inderjit Singh HK, Massey LH, Arulampalam T, Motson RW, Pawa N: Chronic groin pain following inguinal hernia repair in the laparoscopic era: Systematic review and meta-analysis. Am J Surg. 2022, 224:1135-49. 10.1016/j.amjsurg.2022.05.005
14. Canonico S, Benevento R, Perna G, et al.: Sutureless fixation with fibrin glue of lightweight mesh in open inguinal hernia repair: effect on postoperative pain: a double-blind, randomized trial versus standard heavyweight mesh. Surgery. 2013, 153:126-30. 10.1016/j.surg.2012.06.024
15. Beel E, Berrevoet F: Surgical treatment for chronic pain after inguinal hernia repair: a systematic literature review. Langenbecks Arch Surg. 2022, 407:541-8. 10.1007/s00423-021-02311-9