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A Comparative Randomized Control Study between Transabdominal Preperitoneal (TAPP) Repair and Lichtenstein Repair of Inguinal Hernias in a Tertiary Care Center in Delhi NCR

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Abstract:

Introduction: *Inguinal hernia is one of the most encountered surgical conditions globally - with significant prevalence among adult males. Surgical repair remains the definitive treatment and the two predominant techniques - open Lichtenstein repair and laparoscopic Transabdominal Preperitoneal (TAPP) repair - provide differing profiles in terms of operative time, recovery, pain, complications and cost. In the Indian context - evidence comparing these techniques in a controlled environment remains limited.*

Objectives: *To compare TAPP and Lichtenstein repair techniques in terms of intra-operative and post-operative complications, pain outcomes, operative duration, hospitalization time, cost-effectiveness and recurrence in adult patients undergoing elective inguinal hernia repair.*

Methodology: *This was a prospective, randomized controlled study conducted over 18 months at Sharda Hospital, a tertiary care hospital in Delhi NCR. A total of 45 adult patients with uncomplicated inguinal hernias were randomized into TAPP (n=23) and Lichtenstein (n=22) groups. Data collected included demographic profiles, operative parameters, post-operative complications (up to 6 months), VAS pain scores (post-op days 1 and 7), cost and hospital stay. Statistical analysis was performed using SPSS v29.0 - with $p \leq 0.05$ considered significant.*

Results: *TAPP repair showed superior outcomes in pain control with significantly lower VAS scores on day 1 ($p<0.0001$) and day 7 ($p=0.00012$). Mean operative time was longer in TAPP (2.08 ± 0.65 hours) vs. Lichtenstein (1.57 ± 0.62 hours) ($p=0.0105$). Hospital stay was significantly shorter for TAPP (2.04 ± 0.77 days) vs. Lichtenstein (4.95 ± 1.36 days) ($p<0.0001$). Intra-operative complications were rare, with only one vascular injury in the Lichtenstein group. On day 28, TAPP had lower rates of complications: 8.7% cord thickening and 4.35% each for tenderness and seroma; Lichtenstein had 9.09% SSI and 4.55% recurrence. TAPP incurred higher mean cost (₹20,045.45 ± ₹2,516.18) than Lichtenstein (₹15,909.09 ± ₹1,973.86) ($p=0.0001$), largely due to use of laparoscopic equipment.*

Conclusion: *TAPP repair provided significantly better postoperative pain control, earlier discharge and reduced complication rates at the cost of longer operative time and higher expenditure. In well-equipped tertiary centres - TAPP is a superior choice for eligible patients and provides clinical benefits that justify the added cost in suitable cases.*

Keywords: *Inguinal Hernia; Herniorrhaphy; Laparoscopy; TAPP; Lichtenstein Repair; Pain Measurement; Surgical Wound Infection; Cost-Benefit Analysis; Hospital Stay; Randomized Controlled Trial.*

I. INTRODUCTION

Inguinal hernia is a common surgical condition affecting all age groups, particularly adult males, with a global lifetime risk of 27% in men and 3% in women. Over 20 million hernia repairs are done annually worldwide, with inguinal hernias making up the majority. In India, inguinal hernias constitute over 70% of abdominal wall hernias, with more than 2 million surgeries performed each year, though rural data is under-reported.

Hernia repair techniques have evolved from tension-based methods like Bassini and Shouldice to tension-free mesh repairs such as the Lichtenstein technique, which became the gold standard due to its simplicity and effectiveness. Laparoscopic methods like TAPP and TEP emerged in the 1990s, offering benefits like reduced pain and faster recovery, though they are technically demanding and costlier.

Comparisons between Lichtenstein and TAPP show mixed results—TAPP may offer better short-term recovery but raises concerns over cost, complexity, and risks. Lichtenstein, while cost-effective, is linked with chronic groin pain and slower return to activity.

The choice of technique in India is shaped by surgeon preference, institutional protocols, cost, and infrastructure. There is a lack of randomized controlled trials from the Indian context. This study addresses that gap by comparing Lichtenstein and TAPP in adult patients with primary inguinal hernia at a tertiary care center in Delhi NCR, aiming to provide evidence-based guidance on postoperative outcomes specific to Indian healthcare settings.

II. MATERIALS AND METHODS

Study Design: This was a prospective, comparative, randomized controlled trial conducted in the Department of General Surgery at Sharda Hospital, School of Medical Sciences & Research (SMS&R), Greater Noida, Uttar Pradesh. The study was designed to compare the outcomes of Transabdominal Preperitoneal (TAPP) repair and Lichtenstein repair in adult patients with inguinal hernia.

Study Duration: The study was conducted over a period of 18 months from April 2024 to November 2025.

Ethical Approval: The study was initiated after obtaining approval from the Institutional Ethics Committee (IEC) of SMS&R, Sharda University. Informed consent was obtained from all patients participating in the study in both English and Hindi, in compliance with ethical standards for human research.

Study Population: Adult patients aged 18 to 80 years diagnosed with uncomplicated inguinal hernia and deemed fit for elective surgical repair were included in the study. Both male and female patients were considered.

Inclusion Criteria:

- Patients aged between 18 and 80 years.
- Patients diagnosed with painless, uncomplicated inguinal hernias.
- Patients consenting to participate.

Exclusion Criteria:

- Patients younger than 18 or older than 80 years.
- ASA grade III or IV patients (high-risk surgical candidates).
- Patients with massive scrotal, recurrent or complicated hernias.
- History of prior infraumbilical surgery or groin pain due to other causes.
- Emergency surgeries or incarcerated/strangulated hernias.
- Pregnant or immunocompromised patients.

Randomization and Allocation:

Patients were randomly allocated into two groups using the closed envelope method with simple random sampling:

- Group A: Underwent TAPP repair.
- Group B: Underwent Lichtenstein repair.

Sample Size Calculation:

Sample size was calculated using the formula:

$$n = \frac{(Z_{1-\alpha/2} + Z_{\beta})^2 \times p(1-p)}{d^2}$$

Where:

- $Z_{1-\alpha/2}$ =1.96
- Z_{β} = 0.84
- p = 0.052, 1−p = 0.948
- d=0.10

The calculated sample size was 39, with an additional 15% to account for potential dropouts, resulting in a final sample size of 45 patients.

Surgical Procedure:

Both procedures were performed under general or regional anesthesia by experienced surgeons.

- TAPP repair: Laparoscopic access with placement of a mesh in the preperitoneal space. Fixation was performed using titanium tackers (Covidien Protack) or absorbable strap fixation devices (Ethicon Securestrap).
- Lichtenstein repair: Open mesh repair with tension-free placement of mesh over the defect using sutures.

Data Collection:
Parameters were documented using a structured Case Record Form. Data collected included:

- Demographics: Age, gender, BMI, comorbidities.
- Perioperative Details: Type of anesthesia, duration of surgery, length of hospital stay.
- Intraoperative Complications: Visceral injuries (bladder, bowel, stomach), vascular injuries (epigastric bleeding, trocar injury).
- Postoperative Complications:
  - Early (Day 1, Day 7, Day 28): Hematoma, pain, urinary retention, scrotal/genital neuralgia or numbness, wound infection, seroma.
  - Late (6 months follow-up): Chronic groin pain (lasting >3 months), recurrence, testicular atrophy, scrotal/genital swelling.
- Functional Recovery: Time to return to routine work.
- Cost Analysis: Including surgical consumables and hospital stay.

Follow-Up Schedule:

- Post-operative Day 1
- Post-operative Day 7
- Post-operative Day 28
- 6-month follow-up

Statistical analysis: Performed using **IBM SPSS version 29.0** and **Microsoft Excel**. Descriptive and inferential statistical methods were applied to evaluate the data collected throughout the study.

III. RESULT:

Primary Objectives:

1. Intra-operative Complications

- **Findings:** No visceral injuries observed in either group; one vascular complication noted (2.22% overall).
- **Statistical Significance:** Not applicable due to low incidence.
- **Comparison:** Both TAPP and Lichtenstein demonstrated high intra-operative safety; no group showed procedural superiority in this metric.

2. Post-operative Complications

- **Findings:**
  - **POD 1:** TAPP had more cord thickening (17.39%) and scrotal edema (8.7%); Lichtenstein had more SSIs (13.64%) and seromas (9.09%).
  - **POD 7:** TAPP showed lower complications overall; recurrence reported only in Lichtenstein (4.55%).
  - **POD 28:** TAPP continued to have lower infection and recurrence rates; Lichtenstein had 2 SSIs and 1 recurrence.
  - **6 Months:** No complications in TAPP; 1 recurrence in Lichtenstein.
- **Statistical Significance:** Not significant at any time point ($p > 0.05$).
- **Comparison:** TAPP consistently demonstrated fewer late complications and zero recurrence.

3. Post-operative Pain Intensity

- **Findings:**
  - **POD 1:** Lichtenstein group reported higher pain scores (VAS 4–7); TAPP scores remained below 5.
  - **POD 7:** All TAPP patients reported VAS score of 1; Lichtenstein scores ranged from 2 to 5.
  - **POD 28 and 6 Months:** No pain reported in either group.
- **Statistical Significance:** Significant on POD 1 ($p < 0.0001$) and POD 7 ($p = 0.00012$).
- **Comparison:** TAPP demonstrated clear advantage in early post-operative pain relief.

4. Duration of Surgery

- **Findings:** TAPP mean operative time was 2.08 hours; Lichtenstein was 1.57 hours.
- **Statistical Significance:** $p = 0.0105$
- **Comparison:** TAPP required longer surgical duration but provided other recovery benefits.

5. Cost of Procedure

- **Findings:** TAPP cost more (mean ₹20,045.45) compared to Lichtenstein (mean ₹15,909.09).
- **Statistical Significance:** $p = 0.0001$

- **Comparison:** TAPP incurred higher direct costs.

Secondary Objectives:

1. Length of Hospital Stay

- **Findings:** TAPP group had shorter average stay (2.04 days) versus Lichtenstein (4.95 days).
- **Statistical Significance:** $p < 0.0001$
- **Comparison:** TAPP enabled earlier discharge and quicker recovery.

2. Age and Gender Demographics

- **Findings:**
  - **Gender:** Nearly identical in both groups (95% males).
  - **Age Distribution:** Comparable distribution; Lichtenstein had more patients in older age brackets; TAPP concentrated in 30–39 years.
- **Statistical Significance:** Age ($p = 0.24103$); Gender ($p = 1.0$)
- **Comparison:** No significant demographic bias between groups.

3. Hernia Type Distribution

- **Findings:**
  - Lichtenstein had higher proportion of bilateral complete direct and indirect hernias.
  - TAPP showed even distribution with more indirect variants.
- **Statistical Significance:** Not assessed due to data spread.
- **Comparison:** TAPP managed diverse hernia types without increased complication.

Inferences from Results:

1. TAPP provided superior pain control, earlier recovery and fewer post-operative complications.
2. Lichtenstein was faster and less expensive but associated with higher pain, longer hospital stay and early recurrence.
3. TAPP showed no recurrence at six months, while Lichtenstein had one.
4. Hospital efficiency and patient comfort outcomes favoured TAPP despite higher operative costs.

IV. DISCUSSION

This study aimed to systematically compare outcomes between Transabdominal Preperitoneal (TAPP) repair and Lichtenstein repair of inguinal hernias. The research focused on intra-operative complications including visceral and vascular injuries; post-operative complications such as seroma, hematoma, surgical site infection, and recurrence; duration of surgical procedure; and the cost implications of each method. Further assessment included pain intensity over multiple post-operative time points (Day 1, 7, 28, and 6 months), and analysis of hospital stay duration, offering a multi-dimensional understanding of clinical recovery.

The design was a randomized controlled study conducted in a tertiary care centre in Delhi NCR with a sample size of 45 patients. Patients were assigned using simple random sampling. Data collection included intra-operative safety, short- and long-term post-operative morbidity, pain assessment through the Visual Analogue Scale, and resource utilisation metrics such as hospital stay and procedural costs. These parameters were chosen to address existing gaps in comparative evidence from Indian surgical settings, where minimal access approaches are gaining acceptance but lack universal consensus in inguinal hernia management.

Gender Distribution Among Patients: Patient distribution by gender showed near-identical patterns in both groups. TAPP group included 22 males (95.65%) and 1 female (4.35%); Lichtenstein group included 21 males (95.45%) and 1 female (4.55%). Statistical analysis using the chi-square test yielded a p-value of 1.0; thus no significant difference in gender distribution existed between surgical techniques. This parity eliminated gender as a confounding variable and validated equal allocation across groups, allowing unbiased outcome comparisons.

Age Group-wise Distribution by Operation Type: Age-wise analysis showed broader distribution among Lichtenstein patients compared to TAPP. Highest representation in Lichtenstein was from the 50–59 years group (22.73%), followed by 40–49 years (18.18%) and 20–29 years (13.64%). TAPP group was concentrated in the 30–39 years bracket (30.43%), followed by 20–29 and 50–59 years (both 17.39%). Each group included two patients aged 10–19 years. Mean age in Lichtenstein peaked at 70.67 ± 0.58 years in the 70–79 bracket; TAPP peaked at 70.0 years in the same group. Younger mean ages were also comparable between groups. The statistical test returned a p-value of 0.24103, showing no significant age-based difference. Patient age range across both cohorts reflected real-world demographics; surgical assignment by closed envelope randomisation ensured age neutrality and supported homogeneity in outcome interpretation.

Distribution of Type of Hernia by Operation Type: Hernia type distribution showed variability within and between surgical groups. In Lichtenstein repairs, bilateral complete direct hernia was most common (22.73%),

followed by left and right complete indirect hernias (13.64% each). Other presentations included bilateral indirect inguinal (9.09%) and left complete indirect hernia (13.64%). TAPP group showed highest incidence of right and left indirect complete hernias (13.04% each), with remaining cases distributed more evenly across various hernia types including bilateral direct inguinal (13.05% combined). Both groups covered direct, indirect, incomplete, and bilateral variants. Numerical patterns suggested marginal clustering of complex hernias in the TAPP group; however, distribution lacked statistically significant deviation and did not suggest selection bias. The spectrum of hernia morphology across groups enabled comprehensive evaluation of surgical applicability.

Intra-operative Complications in TAPP and Lichtenstein Hernia Repairs: Total intra-operative complication rate was 2.22%. One vascular injury occurred; no visceral injuries were reported. This event was recorded in a single patient among 45 (2.22%) and not attributed preferentially to either TAPP or Lichtenstein group in available data. The absence of visceral injuries indicated adherence to surgical protocols and procedural safety in both techniques. The low complication rate reinforced suitability of both methods for routine inguinal hernia repair. Safety profile consistency aligned with objective of assessing intra-operative events, contributing to reliability of outcome interpretations in broader comparative analysis.

POD 1 – Pain Intensity and Complications by Surgical Technique: Pain scores on post-operative Day 1 differed significantly between groups. In the Lichtenstein group, 36.36% of patients each reported VAS scores of 4 and 5; 13.64% reported 6; and one patient reported 7. No patients had scores below 3. In contrast, TAPP patients reported lower pain levels; 39.13% had a VAS score of 3; 30.43% each reported scores of 2 and 4. No patients in the TAPP group reported pain above 4. Statistical comparison showed a highly significant difference ($p < 0.0001$), favouring TAPP in early post-operative pain control. These findings support the hypothesis that minimally invasive repair offers reduced immediate discomfort, thus aligning with the study's objective of evaluating post-operative pain.

Post-operative complications recorded on Day 1 further supported early benefit in the TAPP group. Cord thickening was present in 4 patients (17.39%) and scrotal edema in 2 patients (8.7%); no cases of seroma or surgical site infection occurred. In contrast, the Lichtenstein group showed higher frequency of surgical site infections (13.64%), seroma (9.09%), and one case of cord thickening (4.55%). No statistical significance was observed in complication rate ($p = 0.3165$); however, the trend indicated a favourable early recovery profile for TAPP. These results aligned with the objective of assessing early post-operative morbidity.

POD 7 – Pain Intensity and Complications by Surgical Technique: Pain assessment on post-operative Day 7 showed uniformity in the TAPP group, where all patients recorded a VAS score of 1. Lichtenstein group demonstrated a broader range; 40.91% reported a score of 2, 27.27% reported 3, 18.18% reported 4, and 13.64% reported 5. No patients in this group had scores below 2. Statistical analysis confirmed a significant difference ($p = 0.00012$), with TAPP providing superior comfort into the subacute recovery phase. Pain relief consistency in TAPP group aligned with prior findings on Day 1, supporting evidence for reduced post-operative discomfort.

Complication profiles on Day 7 maintained the trend seen earlier. In the TAPP group, cord thickening occurred in 2 patients (8.7%), with one case each of tenderness and seroma (4.35% each). Lichtenstein group showed 2 cases of surgical site infection (9.09%) and one recurrence (4.55%); no tenderness, seroma, or cord thickening were recorded. Statistical difference in complication rates was not significant ($p = 0.526$). Recurrence emerging as early as Day 7 in Lichtenstein group raised clinical concern, whereas absence of recurrence in TAPP supported its early post-operative robustness. These findings contributed directly to evaluation of both post-operative morbidity and recurrence, as per study objectives.

POD 28 – Pain Intensity and Complications by Surgical Technique: At post-operative Day 28, pain was no longer recorded numerically, but complications were tracked to evaluate intermediate outcomes. In the TAPP group, 2 patients (8.7%) exhibited persistent cord thickening, while tenderness and seroma were noted in one patient each (4.35%). No cases of surgical site infection, scrotal edema, or recurrence were documented. Lichtenstein group showed 2 cases of surgical site infection (9.09%) and 1 case of hernia recurrence (4.55%); no other complications were observed. Statistical analysis revealed no significant difference in complication rates ($p = 0.841$). Despite the absence of pain scoring, findings indicated that patients in the TAPP group experienced fewer persistent complications by the fourth week. These outcomes suggested continued recovery advantage for TAPP, consistent with earlier data, and addressed the objective of tracking post-operative morbidity through intermediate time points.

POD 6 Months – Pain Intensity and Complications by Surgical Technique: At six months, post-operative follow-up revealed only one recurrence, occurring in a patient who had undergone Lichtenstein repair. TAPP group showed zero recurrences and no cases of chronic pain or other late complications. No pain scores were documented at this stage, indicating complete resolution of discomfort in both groups. These findings demonstrated durable repair and long-term clinical success for both techniques; however, the lone recurrence in the Lichtenstein group pointed to a marginally higher long-term risk. The absence of chronic pain supported the use of TAPP for better patient comfort over time. This final timepoint directly addressed the study objective concerning recurrence and long-term outcome comparison.

Cost Comparison Between TAPP and Lichtenstein Hernia Repairs: Cost analysis revealed significant financial disparity between the two techniques. TAPP repair incurred a mean cost of ₹20,045.45 (± ₹2,516.18) per case, with a range of ₹18,000 to ₹23,000. Lichtenstein repair averaged ₹15,909.09 (± ₹1,973.86), ranging from ₹15,000 to ₹20,000. The cost difference was statistically significant ($p = 0.0001$). TAPP procedures consistently required more resources, largely due to the use of laparoscopic equipment and fixation devices. Despite higher costs, earlier sections demonstrated improved outcomes in terms of pain, recovery, and recurrence. These findings fulfilled the study objective of cost-benefit assessment, indicating a trade-off between superior early outcomes and higher procedural expenditure in TAPP.

Length of Hospital Stay Following TAPP and Lichtenstein Repairs: Length of hospitalisation varied significantly between groups. Patients undergoing Lichtenstein repair had an average stay of 4.95 days (± 1.36), with a range of 3 to 8 days. In contrast, TAPP group had a significantly shorter stay, averaging 2.04 days (± 0.77), ranging from 1 to 4 days. The difference was highly significant ($p < 0.0001$). The consistency of shorter stays in the TAPP group suggested faster recovery and earlier discharge readiness. Reduced hospitalisation aligned with observed trends in pain reduction and lower early complication rates, satisfying the study objective to compare post-operative recovery durations.

Duration Time Comparison Between TAPP and Lichtenstein Hernia Repairs: Operative time differed between techniques. TAPP repair required a mean of 2.08 hours (± 0.65), while Lichtenstein procedures averaged 1.57 hours (± 0.62). The difference was statistically significant ($p = 0.0105$). Despite longer operating times, TAPP resulted in earlier discharge and lower pain scores. These results highlighted a procedural trade-off; TAPP necessitated more surgical time but conferred better recovery indicators. Longer duration did not translate to higher intra-operative complications, reinforcing its procedural safety. These data addressed the objective of evaluating operative duration and its relevance to clinical efficiency.

V. CONCLUSION

Our study aimed to compare Transabdominal Preperitoneal (TAPP) repair and Lichtenstein repair for inguinal hernias in a tertiary care setting. Objectives were to evaluate and compare intra-operative complications and post-operative outcomes which include pain, infection, seroma formation and recurrence; operative time and hospital stay; and overall cost. These metrics were chosen to assess procedural safety, early and long-term recovery, and healthcare resource utilisation between both techniques. Randomisation was applied to ensure balanced distribution and reduce selection bias.

Results indicated equivalent demographic characteristics between both groups which ensured reliability of comparative outcome interpretation. Both surgical techniques demonstrated safety during intra-operative periods without notable visceral injury; one vascular event did not suggest a procedure-specific trend. Post-operative pain was lower in TAPP across all recovery phases and reduced steadily by Day 7 and Day 28, where patients in TAPP group reported minimal or no pain. This pattern continued into six months where no discomfort or chronic pain was observed. Early and intermediate complications were fewer in TAPP; infections and seromas occurred more often in Lichtenstein repairs. Recurrence occurred only in one Lichtenstein patient by six months while TAPP showed none. Lichtenstein surgeries took less operative time; however, patients stayed longer in hospital and reported higher early pain. TAPP cost more per patient and required more surgical time, yet patients recovered sooner and needed fewer follow-ups. These findings suggested that although TAPP involved more operative resources, it resulted in improved short-term and long-term patient outcomes.

Clinical implications extend to recommending TAPP as a viable first-line option for suitable patients who benefit from reduced post-operative pain, earlier discharge and lower recurrence risk. Surgeons may opt for Lichtenstein where resource constraints exist or patient-specific contraindications to laparoscopy arise. Hospital administrators must weigh short-term procedural costs against reduced hospital stay and long-term recovery advantages of TAPP. Early mobilisation, fewer complications and reduced follow-up burden make TAPP more favourable in high-volume centres where resource utilisation efficiency is paramount.

Key insights emerged through repeated observation of pain differentials and consistent absence of recurrence in TAPP cases. Lichtenstein repair, though widely practiced, showed higher pain burden and more wound-related issues. Duration of surgery alone did not dictate patient comfort or safety; TAPP, despite longer time, offered better outcomes. Pain reduction and lower complications suggested that tissue handling and mesh placement dynamics in TAPP were less intrusive and more physiologic. These elements warrant further attention as contributors to long-term quality of life following hernia repair.

Research gaps were observed in long-term follow-up beyond six months which restricted conclusions on chronic pain and recurrence longevity. Patient satisfaction, return to occupational activity and long-term functional status were not studied. Limited sample size, while adequate for initial comparison, may not capture lower-frequency complications or late presentations. Psychological and quality-of-life outcomes remained unexplored and could refine patient-centred evaluation metrics. Cost analysis did not account for indirect costs which may shift value assessments in broader economic models.

Future studies must examine larger multicentric cohorts with extended follow-up to establish recurrence rates and chronic morbidity beyond six months. Comparative evaluations that incorporate patient-reported outcomes, rehabilitation timelines and occupational return may offer broader insights. Laparoscopic skill proficiency and learning curve impacts must be examined to determine procedural adaptability across varying surgical expertise. Studies which investigate tissue biomechanics and mesh integration across techniques may clarify causative links between procedural technique and outcome.

This study concluded that TAPP repair, though more expensive and time-consuming, provided superior post-operative recovery and lower complication rates when compared to Lichtenstein repair. Outcomes favoured TAPP in terms of pain reduction, shorter hospital stay and absence of recurrence. Findings supported adoption of TAPP as a preferred method for elective inguinal hernia repair in suitable patients where resources and surgical expertise permit its application.

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