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ORIGINAL RESEARCH

Comparative Analysis of Biological and Synthetic Mesh Repair in Inguinal Hernia Surgery

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ABSTRACT
Inguinal hernia repair is one of the most common surgical procedures worldwide. The choice of mesh—biological or synthetic—significantly impacts patient outcomes, operative time, and cost-effectiveness. This study aimed to compare demographic, clinical, operative, and postoperative outcomes between the two mesh types in inguinal hernia repair.This retrospective analysis included cases of inguinal hernia repair using biological and synthetic meshes. Demographic variables, comorbidities, operative details, and postoperative outcomes were compared. Statistical significance was assessed for key parameters such as operative time, postoperative complications, and recurrence rates.The study cohort comprised predominantly male patients (96.3%) with a mean age of 50.17 ± 13.8 years. Smoking was prevalent (81.5%), and diabetes mellitus (16.7%) was the most common comorbidity. Biological mesh repairs were associated with significantly longer operative times (91.74 minutes vs. 85 minutes; p = 0.024) and higher rates of complications, including pain (18.5% vs. 3.7%), foreign body sensation (18.5% vs. 3.7%), and seroma formation (22.2% vs. 3.7%; p = 0.043). Wound infections (18.5% vs. 7.4%) and hematoma (18.5% vs. 7.4%) were more frequent in the biological mesh group, though not statistically significant. Recurrence rates were higher with biological mesh (14.8% vs. 7.4%), but differences were also not statistically significant.

INTRODUCTION
Inguinal hernias, with a lifetime risk of 3% in women and 27% in men, represent a significant global health concern [1]. Over 20 million groin hernia repairs are performed annually, emphasizing their widespread prevalence and burden [2,3]. The 2010 Global Burden of Disease Study attributed 11 disability-adjusted life years (DALYs) per 100,000 population per year to groin hernias [4]. Bilateral hernias account for up to 30% of cases, although precise incidence remains unclear [5,6].

Surgical options include primary open repair, open repair with mesh, and laparo-endoscopic techniques, with mesh implantation preferred to reduce recurrence and chronic pain [3,7,10]. Synthetic meshes are standard, but biological meshes are emerging as alternatives, potentially minimizing chronic pain through differential postoperative remodeling [14]. However, comparisons between these two materials in inguinal hernia repair are limited. While synthetic meshes dominate, biological meshes may offer advantages in reducing chronic pain and avoiding complications linked to permanent implants, such as infections [15]. This study compares the efficacy of biological and synthetic meshes in reducing postoperative pain while maintaining comparable recurrence rates.

AIMS AND OBJECTIVES
Aim
Compare the outcomes of biological versus synthetic mesh repair in inguinal hernia surgery.

Objectives
1. Assess postoperative analgesia during recovery and hospital stays.
2. Evaluate patient characteristics (sex, age, BMI, weight) and hernia-related factors (type and history of repair).
3. Analyze postoperative complications and subgroup associations.

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Methodology

Study Design and Population

This study involved 54 adult patients with unilateral inguinal hernia undergoing elective surgery. They were evenly divided into two groups: 27 received biological mesh repairs, and 27 received synthetic mesh repairs. Patient selection was based on their choice of mesh type.

Inclusion Criteria

- Age ≥18 years.
- Admitted to RuxmanibenDeepchand Gardi Medical College (RDGMC) for elective unilateral inguinal hernia repair.

Exclusion Criteria

- Recurrence, congenital hernias, or complicated cases such as strangulated hernias.
- Patients unwilling to participate.

Data Collection

A comprehensive dataset was compiled, including patient demographics (age, sex, weight, BMI), hernia type (direct or indirect), surgical details, and postoperative outcomes. Radiological investigations (ultrasonography) confirmed hernia diagnoses, and standardized surgical protocols ensured consistency. Postoperative assessments occurred at 7 days, 1 month, and 3 months.

Sample Size Calculation

Sample size calculations, based on a 14% pain prevalence estimate and a 95% confidence level, required at least 53 participants. This ensured adequate statistical power and accounted for potential dropouts.

Ethical Considerations

The study was approved by the RDGMC ethics committee. All participants provided informed consent after being briefed on the study's purpose, procedures, and risks.

Statistical Analysis

Data were analyzed using advanced statistical software. Descriptive statistics summarized patient demographics and surgical outcomes, while inferential tests assessed associations between variables. Categorical variables were analyzed using Fisher's exact and Chi-Square tests, with $p < 0.05$ considered statistically significant.

Study Procedures

1. **History and Examination:** A thorough medical history was obtained, including previous surgeries and relevant family health issues. Clinical examinations determined surgical fitness.
2. **Radiological Investigations:** Ultrasonography confirmed diagnoses and aided surgical planning.
3. **Surgical Procedure:** Experienced surgeons performed open surgeries with either biological or synthetic meshes. Details such as duration and intraoperative complications were recorded.
4. **Postoperative Follow-Up:** Complications, pain levels, and recurrence rates were evaluated at designated intervals.

Outcomes and Implications

The study provides comparative data on the effectiveness of biological versus synthetic meshes in reducing postoperative pain and recurrence rates. This evidence may inform surgical decision-making and optimize patient outcomes in inguinal hernia repair. Biological meshes, if proven non-inferior in recurrence and superior in pain reduction, could redefine the standard for hernia repair materials.

This study addresses a critical gap in research and offers insights into optimizing inguinal hernia repair strategies.

OBSERVATIONS AND RESULTS

The **observations and results** of the study can be summarized as follows

Table: 1 Demographic, Baseline and clinical Characteristics

Parameter	Biological Mesh (n=27)	Synthetic Mesh (n=27)	p-value
Mean Age (years)	51.33 ± 13.37	49.00 ± 14.72	0.55
Operative Time (min)	91.74 ± 10.42	85.00 ± 10.87	0.024
Seroma	6 (22.2%)	1 (3.7%)	0.043
Postoperative Pain	5 (18.5%)	1 (3.7%)	0.083
Foreign Body Sensation	5 (18.5%)	1 (3.7%)	0.083
Wound Dehiscence	6 (22.2%)	2 (7.4%)	0.125
Wound Infection	5 (18.5%)	2 (7.4%)	0.224
Hematoma/Bleeding	5 (18.5%)	2 (7.4%)	0.224
Intraabdominal Abscess	3 (11.1%)	2 (7.4%)	0.639
Bulging	5 (18.5%)	2 (7.4%)	0.224
Recurrence	4 (14.8%)	2 (7.4%)	0.386
Mesh Infection	4 (14.8%)	2 (7.4%)	0.386
Reoperation	3 (11.1%)	1 (3.7%)	0.292

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The study evaluated demographic, clinical, and operative characteristics alongside postoperative outcomes in inguinal hernia repair cases using biological and synthetic meshes. The mean patient age was 50.17 ± 13.8 years, with the largest age group being 41–50 years (29.6%). Males predominated (96.3%), and most patients resided in rural areas (79.6%). Smoking prevalence was notably high (81.5%), and diabetes mellitus (16.7%) was the most common comorbidity. Indirect incomplete hernias were the most frequent type (35.2%), followed by direct incomplete (25.9%), direct complete (22.2%), and indirect complete hernias (16.7%). Operative time was significantly longer with biological mesh (91.74 minutes vs. 85 minutes; $p = 0.024$), and the majority of surgeries (63%) were completed in ≤90 minutes. Hospital stays exceeding three days were common (68.5%), and 53.7% of patients resumed work within 30 days.

Postoperative complications were generally higher in the biological mesh group, including pain (18.5% vs. 3.7%), foreign body sensation (18.5% vs. 3.7%), wound dehiscence (22.2% vs. 7.4%), and seroma formation (22.2% vs. 3.7%; $p = 0.043$). Wound infections (18.5% vs. 7.4%) and hematoma formation (18.5% vs. 7.4%) were also more prevalent, though differences were not statistically significant. Bulging (18.5% vs. 7.4%) and recurrence (14.8% vs. 7.4%) were higher in the biological mesh group. Rates of intraabdominal abscess and mesh infection were comparable between groups. These findings highlight the trade-offs between biological and synthetic meshes in hernia repair, with biological meshes associated with longer operative times and higher complication rates but potentially faster return to work.

DISCUSSION

Patient Demographics

The mean age in this study (50.17 years) reflects a younger cohort compared to Miserez et al. (2021), who reported higher mean ages (57 years for synthetic and 63 years for biological meshes) (18). Male predominance (96.3%) in this study aligns with hernia epidemiology but limits applicability to females, unlike Miserez et al. and Bochicchio et al. (2014), which included more balanced gender distributions (18,19). The high smoking prevalence (81.5%) highlights lifestyle-related risks, contrasting with lower rates in Miserez et al. (18).

Intraoperative and Postoperative Outcomes

Operative time was significantly longer for biological meshes (91.74 vs. 85.00 minutes, p=0.024), consistent with Miserez et al. and Bochicchio et al., who noted similar trends (18,19). Postoperative pain, foreign body sensation, and wound dehiscence were higher with biological meshes but did not reach statistical significance. Miserez et al. and Bochicchio et al. also reported higher complication rates with biological meshes, including seromas (18,19). Recurrence rates were slightly higher for biological meshes (7.4% vs. 3.7%), aligning with findings from Bochicchio et al. (19).

Cost and Cost-Effectiveness

Fang et al. (2015) noted longer operative times and significantly higher costs with biological meshes without clinical superiority over synthetic meshes (20). These findings suggest synthetic meshes remain a cost-effective choice for elective hernia repair.

CONCLUSION

While both mesh types are effective, biological meshes are associated with longer operative times and higher short-term complications. However, quicker return to work suggests potential recovery benefits. Mesh selection should balance patient-specific needs and cost-effectiveness to optimize outcomes.

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