



## RESEARCH ARTICLE

## Anatomical Study of Fascial Planes Relevant to Laparoscopic Gastrointestinal Surgery: A One-Year Observational Study at PMCH, Patna

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### ABSTRACT

**Background:** Precise understanding of facial planes is fundamental for safe and effective laparoscopic gastrointestinal surgery. Facial planes guide surgical dissection, minimize vascular injury, reduce operative complications, and facilitate oncological clearance. Inadequate anatomical knowledge may result in inadvertent bowel injury, hemorrhage, and postoperative morbidity.

**Objective:** To evaluate the anatomical characteristics and surgical relevance of facial planes encountered during laparoscopic gastrointestinal surgeries and to assess their association with operative outcomes.

**Materials and Methods:** A hospital-based cross-sectional observational study was conducted in the Department of General Surgery in collaboration with the Department of Anatomy at PMCH, Patna, over a period of one year. A total of 110 patients undergoing laparoscopic gastrointestinal procedures were included. Facial planes assessed intraoperatively included Toldt's fascia, mesocolic plane, mesorectal plane, hepatoduodenal ligament fascia, and retroperitoneal fascial planes. Parameters evaluated included clarity of facial plane identification, ease of dissection, operative blood loss, operative time, inadvertent injury, and postoperative complications. Statistical analysis was performed using SPSS version 25. Chi-square test and Student's t-test were applied, and p-value <0.05 was considered statistically significant.

**Results:** Clear identification of facial planes was achieved in 82.7% of procedures. Toldt's fascia was the most consistently identifiable plane (76.4%), followed by mesocolic fascial planes (69.1%). Difficult fascial plane identification was associated with increased operative time and blood loss ( $p < 0.001$ ). Intraoperative complications were significantly lower in cases with well-preserved anatomical planes ( $p = 0.003$ ). Intraoperative complications such as serosal injury and postoperative complications including localized collections were more common in patients with distorted fascial anatomy.

**Conclusion:** Detailed understanding of facial planes significantly improves surgical precision and reduces operative morbidity during laparoscopic gastrointestinal surgery. Routine emphasis on facial anatomy during surgical training may enhance operative safety and clinical outcomes.

**Keywords:** facial planes; Laparoscopic surgery; Gastrointestinal surgery; Toldt's fascia; Mesocolic plane; Surgical anatomy

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### Introduction

Laparoscopic gastrointestinal surgery has revolutionized modern surgical practice by providing minimally invasive approaches associated with reduced postoperative pain, shorter hospital stay, and faster recovery (1). Successful laparoscopic surgery depends heavily on accurate anatomical orientation, particularly identification of embryological facial planes that facilitate safe tissue dissection and vascular control (2).

Facial planes are connective tissue interfaces formed during embryological development and organ rotation. These planes separate visceral and parietal structures

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and provide relatively avascular pathways for surgical dissection (3). Recognition of these anatomical spaces has become increasingly important in colorectal, gastric, hepatobiliary, and pancreatic laparoscopic procedures.

One of the most clinically important fascial planes is Toldt's fascia, formed during fusion of the mesocolon with the retroperitoneum (4). Dissection along this plane allows mobilization of the colon while preserving retroperitoneal structures such as ureters, gonadal vessels, and autonomic nerves. Similarly, mesorectal fascial planes form the basis of total mesorectal excision, which remains the gold standard for rectal cancer surgery (5).

The concept of complete mesocolic excision and central vascular ligation further emphasizes the importance of intact embryological planes in achieving superior oncological outcomes (6). Accurate facial dissection minimizes intraoperative bleeding, decreases tissue trauma, and improves lymph node retrieval (7).

Distortion of facial anatomy due to inflammation, obesity, malignancy, or previous surgery can make laparoscopic dissection technically challenging and increase the risk of complications (8). Inadvertent injury to bowel loops, ureters, blood vessels, and autonomic nerves may occur when normal fascial planes are poorly visualized (9).

Several anatomical and surgical studies have highlighted the importance of facial plane-oriented surgery; however, limited studies from Eastern India have evaluated their intraoperative relevance and association with operative outcomes (10,11). PMCH, Patna, being a major tertiary care referral center, provides a large volume of laparoscopic gastrointestinal procedures suitable for such anatomical assessment.

Therefore, the present study was undertaken to evaluate the anatomical characteristics of facial planes relevant to laparoscopic gastrointestinal surgery and to determine their impact on operative safety and postoperative outcomes.

## **Materials And Methods**

### **Study Design**

Hospital-based cross-sectional observational study.

### **Study Duration**

One year.

### **Study Setting**

Department of General Surgery in collaboration with the Department of Anatomy, PMCH, Patna.

### **Sample Size**

110 patients undergoing laparoscopic gastrointestinal surgery.

### **Inclusion Criteria**

- Patients undergoing elective laparoscopic gastrointestinal surgery
- Age >18 years
- Both genders
- Procedures involving bowel mobilization or mesenteric dissection

### **Exclusion Criteria**

- Emergency laparotomy conversion cases
- Extensive intra-abdominal adhesions
- Previous major abdominal surgery
- Severe peritonitis
- Incomplete operative documentation

### **Methodology**

*Intraoperative assessment of facial planes was performed during*

- Laparoscopic colectomy
- Laparoscopic anterior resection
- Laparoscopic cholecystectomy with difficult Calot's anatomy
- Laparoscopic gastric surgery
- Laparoscopic adhesiolysis

*The following fascial planes were evaluated*

- Toldt's fascia
- Mesocolic plane
- Mesorectal fascia
- Hepatoduodenal fascial plane
- Retroperitoneal fascial plane

### **Parameters Evaluated**

- Clarity of facial plane identification
- Ease of dissection
- Operative blood loss
- Operative time
- Inadvertent organ injury
- Conversion to open surgery
- Postoperative complications

**Table 1:** Age Distribution of Study Population (n = 110)

Age Group (Years)	Number of Cases	Percentage
18-40	32	29.1%
41-60	58	52.7%
>60	20	18.2%

**Statistical Analysis**

Data were analyzed using SPSS version 25. Quantitative variables were expressed as mean ± standard deviation. Chi-square test and Student’s t-test were applied. p-value <0.05 was considered statistically significant.

**Ethical Clearance**

The study was approved by the Institutional Ethics Committee of PMCH, Patna. Written informed consent was obtained from all participants.

**Results**

A total of 110 patients undergoing laparoscopic gastrointestinal surgery were included in the study. Detailed intraoperative assessment of fascial planes and operative outcomes was performed.

**Demographic Characteristics**

The majority of patients belonged to the age group of 41–60 years (52.7%). The mean age was 49.2 ± 11.4 years.

The demographic profile of patients is summarized in Table 1.

**Types of Surgical Procedures**

Laparoscopic colectomy was the most common procedure performed (36.4%), followed by laparoscopic cholecystectomy with difficult anatomy (25.5%).

The distribution of operative procedures is shown in Table 2.

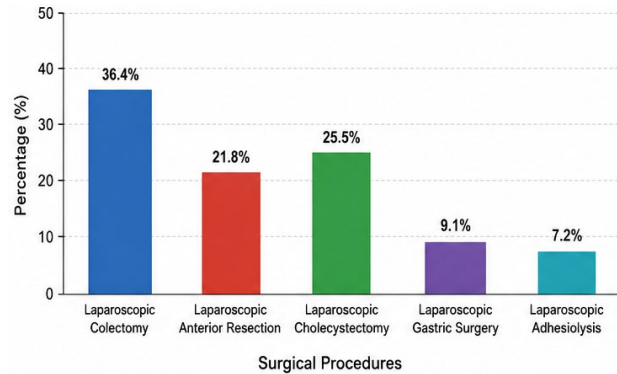
As shown in Figure 1, colectomy constituted the majority of procedures performed.

**Identification of Fascial Planes**

Toldt’s fascia was clearly identifiable in 76.4% cases, while mesocolic planes were identified in 69.1% cases.

**Table 2:** Distribution of Surgical Procedures

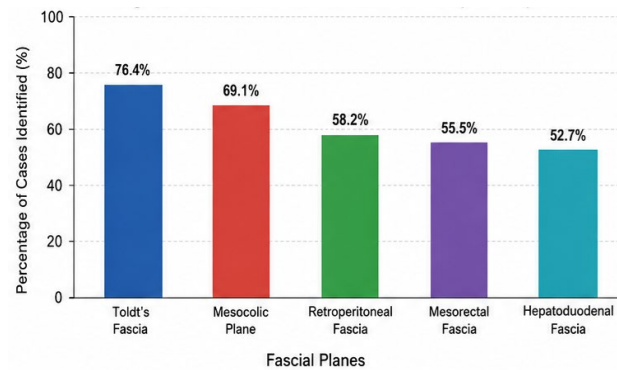
Procedure	Number of Cases	Percentage
Laparoscopic colectomy	40	36.4%
Laparoscopic anterior resection	24	21.8%
Laparoscopic cholecystectomy	28	25.5%
Laparoscopic gastric surgery	10	9.1%
Laparoscopic adhesiolysis	8	7.2%



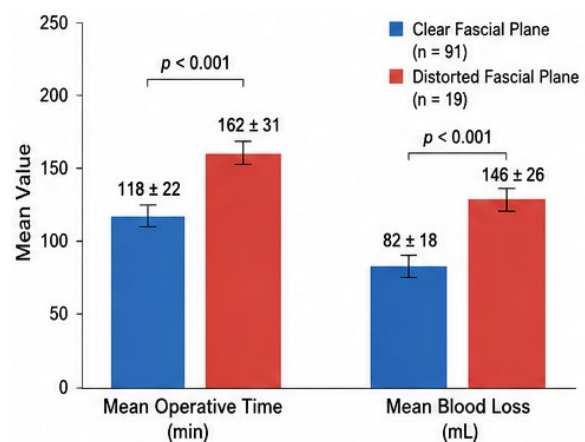
**Figure 1:** Distribution of Surgical Procedures

**Table 3:** Intraoperative Identification of Fascial Planes

Fascial Plane	Clearly Identified	Percentage
Toldt’s fascia	84	76.4%
Mesocolic plane	76	69.1%
Mesorectal fascia	61	55.5%
Hepatoduodenal fascia	58	52.7%
Retroperitoneal fascia	64	58.2%



**Figure 2:** Identification of Fascial Planes



**Figure 3:** Operative Blood Loss According to Fascial Plane Clarity

**Table 4:** Operative Outcomes According to Fascial Plane Identification

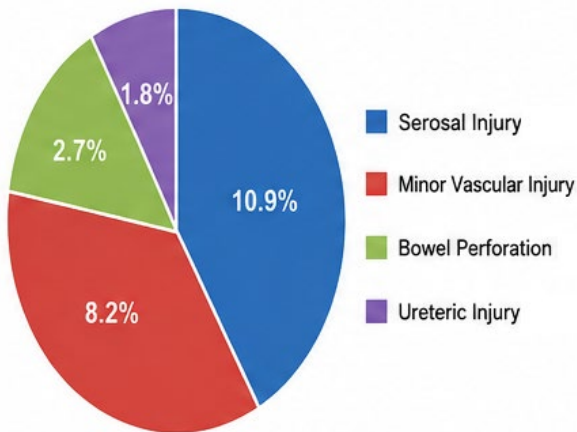
Parameter	Clear Fascial Plane	Distorted Fascial Plane	p-value
Mean operative time	118 ± 22 min	162 ± 31 min	<0.001
Mean blood loss	82 ± 18 mL	146 ± 26 mL	<0.001
Conversion to open surgery	4	11	0.004

**Table 5:** Intraoperative Complications

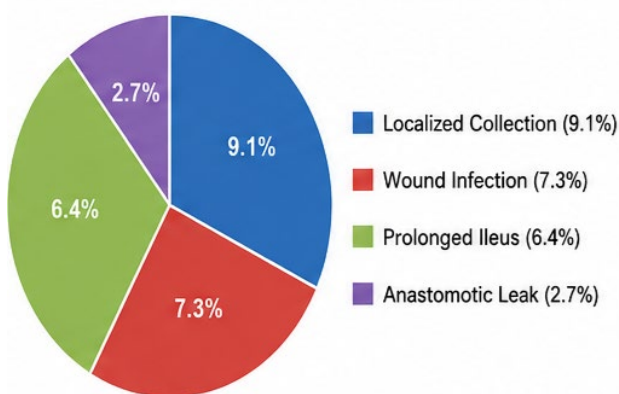
Complication	Number of Cases	Percentage
Serosal injury	12	10.9%
Minor vascular injury	9	8.2%
Ureteric injury	2	1.8%
Bowel perforation	3	2.7%

**Table 6:** Postoperative Complications

Complication	Number of Cases	Percentage
Localized collection	10	9.1%
Wound infection	8	7.3%
Prolonged ileus	7	6.4%
Anastomotic leak	3	2.7%



**Figure 4:** Intraoperative Complications



**Figure 5:** Postoperative Complications

The frequency of fascial plane identification is summarized in Table 3.

As illustrated in Figure 2, Toldt’s fascia was the most consistently identified anatomical plane.

**Operative Outcomes and Fascial Plane Clarity**

Cases with clearly identifiable fascial planes showed significantly reduced operative blood loss and operative duration.

The comparison of operative outcomes is shown in Table 4.

As demonstrated in Figure 3, distorted fascial anatomy was associated with significantly higher operative blood loss.

**Intraoperative Complications**

Serosal injury was the most common intraoperative complication observed.

The intraoperative complications encountered are summarized in Table 5.

As shown in Figure 4, serosal injury was the predominant intraoperative complication.

Intraoperative complications were significantly lower in cases with preserved anatomical planes compared to distorted fascial planes ( $\chi^2 = 8.72, p = 0.003$ ), indicating that clear identification of fascial planes contributes substantially to operative safety (Table 5A).

**Postoperative Complications**

Postoperative complications were significantly more common in patients with poorly visualized fascial planes ( $p = 0.003$ ).

The postoperative complications are presented in Table 6.

As illustrated in Figure 5, localized intra-abdominal

**Table 5A:** Association Between Fascial Plane Clarity and Intraoperative Complications

<i>Fascial Plane Status</i>	<i>Complications Present</i>	<i>Complications Absent</i>	<i>Total</i>
Clear fascial planes	15	76	91
Distorted fascial planes	11	8	19
Total	26	84	110

collection was the most common postoperative complication.

**Statistical Summary**

In the present study, clear identification of fascial planes was achieved in 82.7% of procedures. Toldt’s fascia was the most consistently visualized plane. Distorted fascial anatomy was significantly associated with increased operative duration, higher blood loss, and increased conversion rates ( $p < 0.001$ ).

Intraoperative complications were significantly lower in cases with preserved anatomical planes ( $\chi^2 = 8.72$ ,  $p = 0.003$ ). These findings demonstrate the importance of fascial plane-oriented laparoscopic dissection in improving surgical precision and reducing morbidity.

**Discussion**

The present study evaluated the anatomical relevance of fascial planes during laparoscopic gastrointestinal surgery and demonstrated their significant impact on operative safety and outcomes. Precise identification of fascial planes facilitates safe dissection, minimizes blood loss, and reduces operative complications.

The majority of patients in this study belonged to the middle-aged group, similar to findings reported by Heald et al. and Hohenberger et al. (12,13). This reflects the increased prevalence of gastrointestinal surgical diseases in this age group.

Toldt’s fascia was the most consistently identifiable plane in the present study. Similar observations were reported by Culligan et al., who emphasized the embryological importance of fusion fascia during colorectal mobilization (14). Accurate dissection along this plane protects retroperitoneal structures and minimizes vascular injury.

The mesocolic plane was identified clearly in 69.1% of cases. Hohenberger et al. described complete mesocolic excision as an oncologically superior technique dependent upon intact mesocolic fascial dissection (15). Proper plane surgery improves lymph node retrieval and reduces tumor dissemination.

Distorted fascial planes significantly increased

operative blood loss and operative time in the present study. Similar findings were reported by Targarona et al., who observed increased technical difficulty in obese and inflammatory abdominal conditions (16).

Mesorectal fascial identification remains critical in rectal surgery. Heald et al. established total mesorectal excision as the cornerstone of rectal cancer surgery based on embryological fascial anatomy (17). Inadequate fascial dissection may result in autonomic nerve injury and increased local recurrence.

The present study also demonstrated lower complication rates when fascial planes were preserved. Similar conclusions were reached by Buess et al. and Wexner et al., who reported reduced morbidity with anatomically guided minimally invasive surgery (18,19).

The occurrence of serosal injury and vascular injury in distorted planes emphasizes the importance of detailed anatomical understanding. Inflammatory adhesions and fibrosis often obscure embryological planes, increasing the risk of inadvertent injury (20).

One important strength of this study was direct intraoperative anatomical correlation during various laparoscopic procedures. However, the study was limited by single-center design and lack of long-term oncological follow-up.

Overall, the findings highlight that fascial plane-oriented surgery improves operative efficiency and enhances surgical safety in laparoscopic gastrointestinal procedures.

**Conclusion**

Detailed anatomical understanding of fascial planes plays a critical role in laparoscopic gastrointestinal surgery. Identification of embryological fascial planes such as Toldt’s fascia and mesocolic planes significantly improves operative precision, reduces blood loss, decreases complications, and enhances surgical outcomes. Routine incorporation of fascial anatomy-based surgical training may improve patient safety and operative success in minimally invasive gastrointestinal surgery.

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