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The Analysis Study of Incisional Hernia at The Extraction Site Following Minimally Invasive Colorectal Surgery : A Comprehensive Systematic Review

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ABSTRACT

Background: This study aims to provide a comprehensive systematic review to evaluate the efficacy and safety of EUS-GE in comparison to both ES and SGJ for treating malignant GOO. **Methods:** Following PRISMA 2020 guidelines, this systematic review focused exclusively on full-text articles published in English between 2014 and 2024. **Result:** The study conducted a comprehensive review of over 100 publications sourced from reputable databases, including ScienceDirect, SagePub, and PubMed. Following an initial screening, eight publications were identified as warranting more in-depth analysis. Consequently, a thorough review of these selected studies was performed to ensure a detailed and rigorous evaluation. **Conclusion:** EUS-GE shows promise for treating malignant GOO with higher success rates and fewer complications compared to traditional methods. However, further development of specialized devices and standardization of the technique, along with more robust randomized trials, are necessary to better understand and establish its role in clinical practice.

Keyword: abdominal wall, extraction site, incisional hernia

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INTRODUCTION

The adoption of minimally invasive techniques has significantly benefited patients undergoing colorectal surgery for both cancer and non-cancer conditions. Compared to traditional open surgery, minimally invasive procedures generally offer comparable or improved outcomes with fewer complications. Patients experience smaller incisions, shorter hospital stays, and a lower incidence of complications such as surgical site infections (SSI) and surgical site occurrences (SSO) with minimally invasive colorectal surgery.[1–3]

Laparoscopic colorectal surgery, in particular, has notably reduced the risk of incisional hernia (IH), with recent studies showing an odds ratio (OR) of 0.79 (95% CI 0.66–0.95). Despite this, there remains a risk of extraction site incisional hernia (ESIH), which can occur in up to 12.6% of cases after an average follow-up period of 5.9 years in large patient series.[4]

Minimally invasive abdominal surgeries often involve the removal of a surgical specimen through an extraction site, which may involve enlarging an existing incision or creating a new one. The size of the extraction site is influenced by the technique used and the size of the specimen. Although the exact relationship between incision size and the risk of IH is not fully understood, it is generally accepted that larger incisions increase the likelihood of IH.[5]

ESIH can become symptomatic, necessitating surgical intervention due to issues such as pain, incarceration, and impaired abdominal wall function. IH can also affect body image and quality of life (QoL). While surgery is effective, it can be invasive, requiring large dissections and mesh implantation, and it carries risks of postoperative complications like SSI or SSO (seroma, hematoma) and long-term recurrence.[6]

The location of the extraction site can vary depending on the type of surgery, with common sites including midline, periumbilical, paramedian, transverse, Pfannenstiel, and stoma-site. Research has shown varying incidence rates for different extraction sites. The most recent systematic review from 2017 found that

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midline extraction sites have a significantly higher risk of IH compared to Pfannenstiel or non-midline sites such as transverse. Since then, several large studies have further investigated extraction sites.[7,8]

This study aims to provide a comprehensive systematic review to evaluate incidence rates of ESIH for different extraction sites and to analyze other postoperative complications associated with each site.

METHODS

Protocol

The investigation was carried out with scrupulous conformity to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 criteria, guaranteeing strict respect to accepted methodological principles. Strictly following PRISMA 2020 standards demonstrates a dedication to improving the clarity, replicability, and systematic thoroughness of the review process. The study incorporated thorough methodologies for conducting literature searches, extracting data, and synthesizing findings. These methods were well implemented to minimize biases and guarantee the strength of the conclusions.

Criteria for Eligibility

The present study offers a comprehensive examination of the studies undertaken throughout the last ten years. Through the methodical examination and integration of data from other studies, this research seeks to clarify patterns and guide the improvement of patient care approaches for this group with multiple health conditions.

The main aim of this thesis is to highlight important themes that arise from a wide range of scholarly literature. In order to guarantee the thoroughness and precision of the study, strict criteria for inclusion and exclusion were implemented. Only English-language peer-reviewed papers published from 2014 to 2024 were considered suitable for inclusion. Materials eligible for inclusion must also possess a DOI for the purpose of confirming their authenticity. In order to preserve the focus and integrity of the dataset, the analysis in question deliberately omitted non-

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research materials, including reviews, editorials, and duplicate entries from the same publication.

The systematic methodology employed in this study guarantees that the data used is both pertinent and trustworthy, therefore establishing a strong basis for deriving significant findings and progressing clinical practice.

Search Strategy

We used "((abdominal wall) AND (extraction site)) AND (incisional hernia)" as keywords. The search for studies to be included in the systematic review was carried out using the PubMed, SagePub, and Sciencedirect databases.

Data retrieval

The authors conducted a thorough preliminary review of each article by examining its abstract and title to assess relevance before proceeding with a more detailed investigation. Only studies that aligned with the study's objectives and met the predefined inclusion criteria were considered for further review. This method allowed for the identification of a clear and consistent pattern across the research.

Full-text articles were restricted to those published in English to maintain consistency in the language of the studies. A rigorous screening process was applied to select content that was directly relevant to the study's focus and adhered to all established inclusion criteria. Articles not meeting these criteria were systematically excluded from further analysis and not included in the final evaluation.

The evaluation process included a comprehensive review of various factors such as study design, titles, authors, publication dates, research locations, and methodologies. This meticulous approach ensured that the content analyzed was of the highest relevance and quality, thereby strengthening the overall findings of the study.

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Quality Assessment and Data Synthesis

The authors performed a meticulous review of each article's abstract and title to identify those deserving further investigation. After this initial screening, all relevant documents underwent a comprehensive examination. The results of this evaluation guided the selection of review papers, ensuring that only the most pertinent studies advanced to detailed analysis. This rigorous approach streamlined the selection process and facilitated a thorough and nuanced assessment of the existing research and its context.

Table 1. Search Strategy

Database	**Search Strategy**	***Hits***
Pubmed	((abdominal wall) AND (extraction site)) AND (incisional hernia)	7
Science Direct	((abdominal wall) AND (extraction site)) AND (incisional hernia)	79
Sagepub	((abdominal wall) AND (extraction site)) AND (incisional hernia)	17

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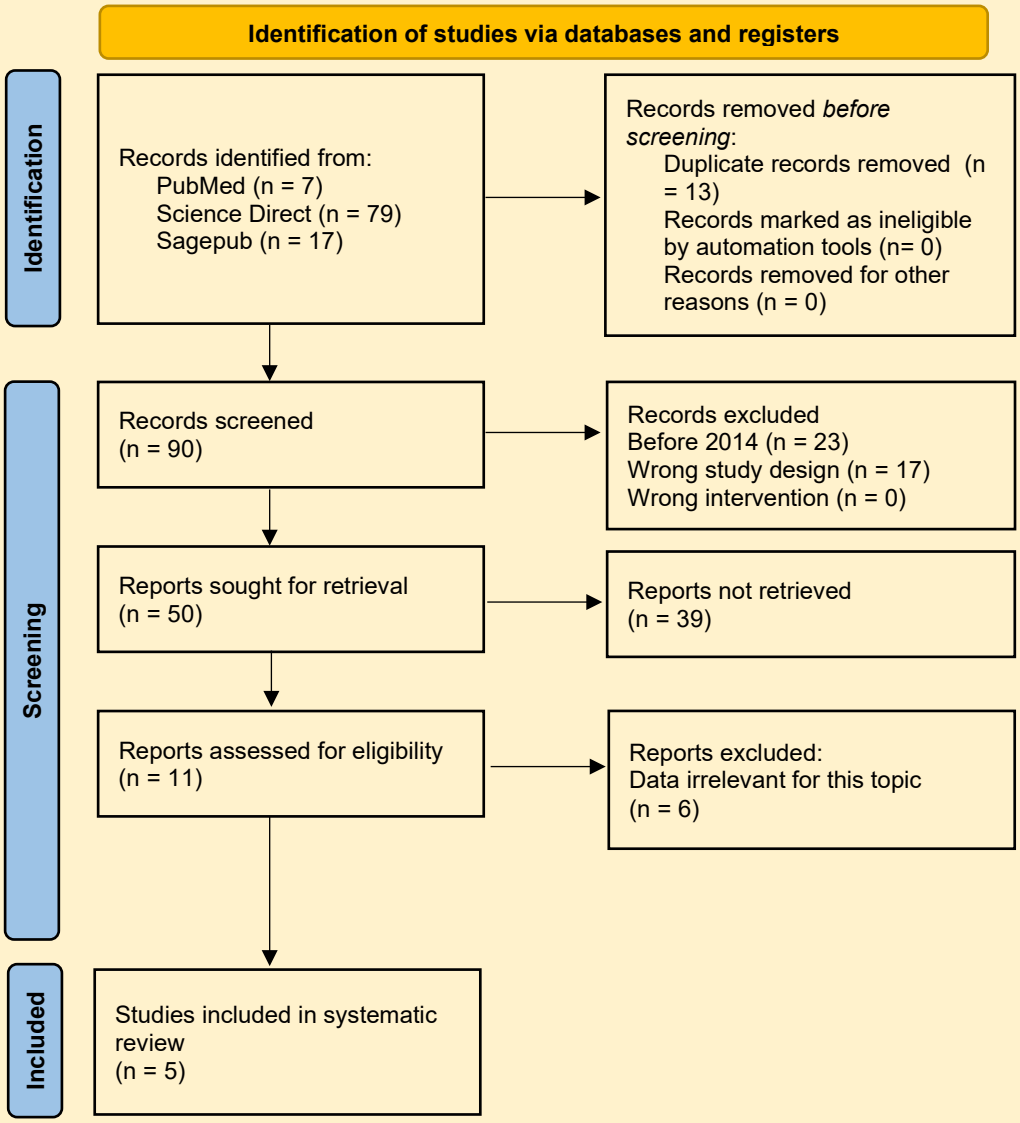


Figure 1. Article search flow chart

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Table 2. Critical appraisal of Study

Parameters	Bartels (2014)	Varathan (2020)	Cano (2020)	Choi (2022)	Benlice (2016)
1. Bias related to temporal precedence					
Is it clear in the study what is the "cause" and what is the "effect" (ie, there is no confusion about which variable comes first)?	Yes	Yes	Yes	Yes	Yes
2. Bias related to selection and allocation					
Was there a control group?	No	Yes	No	No	No
3. Bias related to confounding factors					
Were participants included in any comparisons similar?	No	No	No	No	No
4. Bias related to administration of intervention/exposure					
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	Yes.	Yes.	Yes.	Yes.	Yes.
5. Bias related to assessment, detection, and measurement of the outcome					
Were there multiple measurements of the outcome, both pre and post the intervention/exposure?	No	No	No	No	No
Were the outcomes of participants included in any comparisons measured in the same way?	Yes	Yes	Yes	Yes	Yes
Were outcomes measured in a reliable way?	Yes	Yes	Yes	Yes	Yes
6. Bias related to participant retention					
Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analyzed?	No	Yes	No	No	No
7. Statistical conclusion validity					
Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes	Yes

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RESULT

We initiated the investigation by systematically gathering a significant assortment of papers from reputable sources such as Science Direct, PubMed, and SagePub. After a thorough three-stage screening process, we selected eight papers that were considered very pertinent to our ongoing systematic inquiry. Subsequently, we selected certain topics for further examination and meticulously evaluated each report. In order to expedite our study, we have included a concise summary of the evaluated information in Table 3.

Table 3. The literature included in this study

Author	Origin	Method	Sample	Result
Bartels, et al.[9] (2014)	Netherlands	Retrospective cohort study	400 patients	Data on incisional hernias, SBO, survival and recurrence were available for 399 of 400 patients: 208 laparoscopic and 191 open resections. These outcomes were corrected for duration of follow-up. Median follow-up was 3·4 (i.q.r. 2·6-4·4) years. Multivariable regression analysis showed that open resection was a risk factor for incisional hernia (odds ratio (OR) 2·44, 95 per cent confidence interval (c.i.) 1·12 to 5·26; P = 0·022) and SBO (OR 3·70, 1·07 to 12·50; P = 0·039). There were no differences in overall survival (hazard ratio 1·10, 95 per cent c.i. 0·67 to 1·80; P = 0·730) or in cumulative incidence of recurrence (P = 0·514) between the laparoscopic and open groups. There were no measured differences in QoL in 281 respondents (P > 0·350 for all scales).

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Varathan, et al.[10] (2020)	Switzerland	Retrospective cohort study	269 patients	After matching 77 patients in the LLT group and 77 patients in the P-K group, they were found to be homogenous regarding the above mentioned descriptive characteristics. No patients in the P-K group developed an incisional hernia compared with 10 patients (13%) in the LLT group (p = 0.001). All these patients required hernia repair with mesh augmentation. The rate of surgical site infections was 1/77 in the P-K group and 0/77 in the LLT group (p = 1.0). In the P-K group, a wound protector was used in 86% of patients whereas in the LLT group, 39% of the wounds were protected during specimen extraction (p < 0.0001).
Cano, et al.[11] (2020)	Spain	Retrospective cohort study	225 patients	Two hundred and twenty-five patients were included. More than 80% of the patients had a malignant disease. Ninety-two patients (40.9%) underwent right colectomy. Midline extraction-site incision was used in 86 (38.2%) patients. After a mean follow-up of 2.4 years, 39 (17.3%) patients developed an extraction-site incisional hernia. Midline extraction-site incision was associated with incisional hernia when compared to transverse and Pfannenstiel incision (39.5% vs. 3.6%, OR 17.5, p < 0.001). Surgery to repair an extraction-site incisional hernia was also more frequent in the group of

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				patients with a midline incision (10.5% vs. 1.4%, OR 8.0, p = 0.002). In the multivariate analysis, incisional hernia was associated with body mass index, high blood pressure, and midline incision.
Choi, et al.[12] (2022)	Korea	Retrospective cohort study	2704 patients	During the median follow-up of 41 months, 73 patients (2.7%) developed IH. Midline incision group (n = 1472) had a higher incidence of IH than that of transverse incision group (n = 1232) (3.5% vs. 1.7%, p = 0.003). The univariable analysis revealed that the risk factors of developing IH were old age, female gender, obesity, co-morbid cardiovascular disease, transverse incision for specimen extraction, and perioperative bleeding requiring transfusion. However, on multivariable analysis, specimen extraction site was not significant in developing IH and transfusion requirement was the strongest risk factor.
Benlice, et al.[13] (2016)	USA	Retrospective cohort study	2148 patients	A total of 2148 patients (54.0% with abdominal and 46.0% with pelvic operations) with a mean age of 51.7 ± 18.2 years (52% women) were reviewed. Used extraction sites were infraumbilical midline (23.7%), stoma site/right or left lower quadrant (15%),

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				periumbilical midline (22.5%), and Pfannenstiel (29.6%) and midline converted (9.2%). Overall crude extraction site incisional hernia rate during a mean follow-up of 5.9 ± 3.0 years was 7.2% (n = 155). Extraction-site incisional hernia crude rates were highest after periumbilical midline (12.6%) and a midline incision used for conversion to open surgery (12.0%). Independent factors associated with extraction-site incisional hernia were any extraction sites compared with Pfannenstiel (periumbilical midline HR = 12.7; midline converted HR = 13.1; stoma site HR = 28.4; $p < 0.001$ for each), increased BMI (HR = 1.23; $p = 0.002$), synchronous port-site hernias (HR = 3.66; $p < 0.001$), and postoperative superficial surgical-site infection (HR = 2.11; $p < 0.001$).

DISCUSSION

The current analysis indicates a lower incidence of extraction site incisional hernia (ESIH) following minimally invasive colorectal surgery when using non-midline or Pfannenstiel incisions, with Pfannenstiel showing the lowest rate at 2.1%. Pfannenstiel extraction sites consistently demonstrate the best results, with significantly lower odds ratios for ESIH compared to other sites.[9]

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Previous studies reported a 12.6% incidence of incisional hernia for midline extractions. In this analysis, the ESIH rate for midline extractions is 16.0%, aligning with existing literature. The technical challenge of closing the fascia after a small midline laparotomy may contribute to this higher incidence, as minimizing the skin incision size to retain the benefits of minimally invasive surgery limits exposure during closure.[10]

Patients with midline extraction sites have over three times the risk of IH compared to those with non-midline extractions. Interestingly, the rates of surgical site infections (SSI), seroma/hematoma, and wound dehiscence are similar across sites, suggesting other factors might contribute to the difference in IH incidence. Similar trends have been observed in open colorectal surgery, where midline extractions are associated with higher IH rates compared to non-midline sites.[11]

Surgeons may have varying preferences for extraction sites based on anatomical considerations. For instance, those performing upper abdominal surgeries might be less familiar with the Pfannenstiel incision. If Pfannenstiel is less feasible due to severe adhesions, midline extraction should be avoided when possible. In right colectomy, midline and umbilical extractions are common for extracorporeal anastomosis, but intracorporeal anastomosis allows for specimen extraction through Pfannenstiel, offering potential advantages.[12]

A potential drawback of Pfannenstiel is the risk of urinary bladder injury, particularly in patients with a history of bladder surgery or cesarean sections.Natural orifice transluminal endoscopic surgery, which avoids abdominal wall incisions, theoretically eliminates the risk of IH but introduces other specific risks such as organ prolapse and tissue granulation.[13]

CONCLUSION

Pfannenstiel incision appears to offer the lowest incidence of ESIH, making it preferable for specimen extraction in minimally invasive colorectal surgery. Midline incisions should be avoided if possible.

DISCLOSURE STATEMENT

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Disclosure Statement : The authors have no conflicts of Interest to declare.

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