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Comparison between abdominal wall closure techniques in the incidence of incisional hernias: a systematic review

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ABSTRACT

OBJECTIVE

To compare different suture techniques, and suture materials in the incidence of incisional hernias and postoperative complications, which is essential to determine the ideal suture.

METHODS

This study is a systematic review. Data collection occurred from the analysis of studies between 1983 and 2024, extracted from the MEDLINE, SciELO and Latin-American and Caribbean Literature (LILACS) databases.

RESULTS

Continuous suture demonstrated advantages in emergency surgery environments due to the shorter exposure time of the patient. Absorbable monofilament sutures, such as polyglyconate, showed resistance and lower complication rates, but did not show significant differences in the incidence of hernias compared to non-absorbable wires. The use of triclosan in absorbable wires can reduce wound infections without significant impact on the incisional hernias rate.

CONCLUSION

The study concludes that there is no definitive advantage of one suture technique over another in the prevention of incisional hernias, but continuous sutures are beneficial to reduce surgical time in emergencies. The choice of technique and suture material should balance the effectiveness in preventing hernias, minimizing complications and the clinical context of each patient.

KEYWORDS

Incisional Hernia; Abdominal Wall Closure Technique; Comparison.

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INTRODUCTION

Incisional hernias (IH) constitute relevant complications after laparotomies, being defined as defects in the abdominal wall at the site of a previous surgical incision, with or without a noticeable protrusion on clinical inspection or imaging examinations. These defects can be classified according to location, size, recurrence, reducibility, and symptoms. Several risk factors are associated with their development, including previous abdominal surgeries, smoking, and recent acute infections. In addition, certain surgical techniques, such as the transumbilical approach, may present a higher incidence of IH.[1]

The incidence of IH after elective midline laparotomies ranges from 12% to 22% in the first three postoperative years, being more common in patients with predisposing factors such as rectus diastasis, pre-existing umbilical hernia, and smoking.[2] The incidence of IH is significantly high in studies analyzing the use of the transumbilical "single-port" (SP) approach for SP procedures, due to the need for a larger aponeurotic incision when compared with that used in laparoscopic cholecystectomy (VLC), often in patients with diastasis.[3] For the European Hernia Society (EHS), to prevent IH incidence, a non-midline approach is recommended for laparotomy.[4]

The incidence of IH in open surgery is high, as in abdominal aortic aneurysm repair, occurring more frequently in midline incisions and being directly related to the technique used for aponeurotic closure. This requires the surgeon to pay special attention to this surgical step in order to avoid the most common cause of reoperation in this group of patients.[5]

The most commonly used techniques for abdominal wall closure are continuous suture and interrupted suture. The first is indicated for extensive wounds under minimal tension, allowing rapid closure and homogeneous distribution of force along the incision, although it carries a higher risk of dehiscence if the thread breaks. Interrupted suture, in turn, provides greater tensile strength, offers better aesthetic results, and reduces the risk of vascular compromise, being indicated for wounds under higher tension. A relevant technical aspect is the suture length-to-wound length ratio, which should be greater than four, as lower values increase the risk of IH by up to fourfold.[6-8]

Monofilament sutures may reduce hernia risk in patients and may be considered over multifilament sutures, just as continuous sutures using slowly absorbable material also demonstrate lower chances of IH development.[9,10]

Regarding suture materials and threads types, these can be divided into absorbable or non-absorbable, each with distinct characteristics. Absorbable threads, such as polyglactin, are frequently used in deeper layers, reducing tension and favoring healing. Non-absorbable threads, such as polypropylene, are preferred in superficial layers due to their greater resistance and durability. Evidence indicates that monofilament sutures present a lower infection risk compared with multifilament sutures, and that continuous sutures with slowly absorbable threads are associated with a lower incidence of IH. In the context of mesh fixation, the ideal thread should provide high functional strength, a monofilament structure — which hinders bacterial colonization — and absorbable properties, allowing its elimination as a potential source of infection.[11]

Based on this, the present study aimed to compare different abdominal wall closure techniques, such as continuous or interrupted sutures, and to distinguish between the types of threads used, including non-absorbable threads or long-lasting absorbable threads, preferably monofilament, in the incidence of incisional hernias. Additionally, it seeks to evaluate the incidence of incisional hernias in patients undergoing continuous versus interrupted suture, compare wound closure outcomes using absorbable versus non-absorbable sutures, and identify potential complications associated with each technique and suture material.

Thus, this study is further justified by the need to identify the most effective approach to reduce the incidence of incisional hernias. A detailed understanding of these variables may guide surgical practices and improve postoperative outcomes.

METHODS

Study type

The present study consisted of a systematic literature review of publications in journals from 1983 to 2024, aiming to compare abdominal wall closure techniques regarding the incidence of IH.

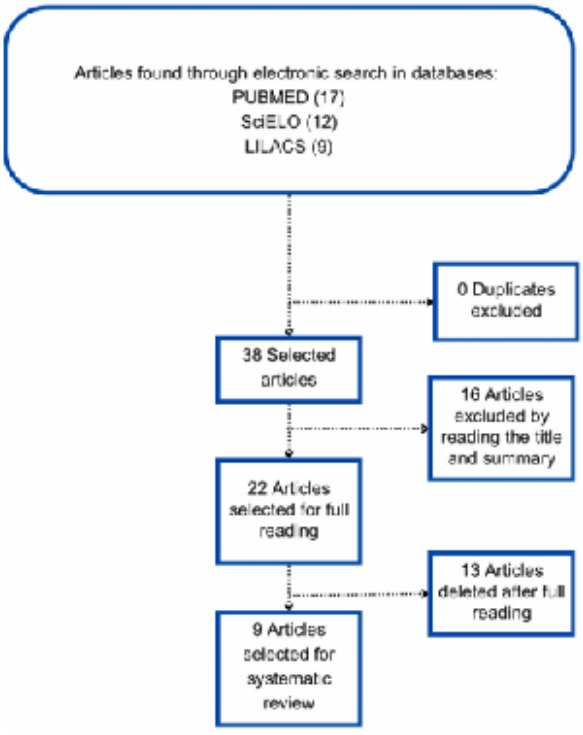
Data collection procedures

Data collection was carried out through a bibliographic survey of randomized clinical trials, and such studies were retrieved in full using the following descriptors and their respective Boolean operators: *"hérnia incisional", "técnicas de fechamento abdominal", "Incisional Hernia", "Abdominal Wall Closure", "Fascia closure", "Wound Closure", "Abdominal Wall Repair", "Suture Techniques", "Continuous Closure", "Running Suture", "Interrupted Suture", "Interrupted Closure", "Absorbable Sutures", "Non- Absorbable Sutures", "polydioxanone suture", "Permanent Sutures", "nylon", "Monofilament", and "Multifilament"*. The search was conducted in the databases National Library of Medicine (PubMed), Scientific Electronic Library Online (Scielo), and Latin American and Caribbean Health Sciences Literature (LILACS).

The PICO acronym was used as a strategy for defining the clinical question, with the following meanings: P: Population/Problem; I: Interest/Intervention; C: Comparison; and O: Outcomes. Based on this, the present study aims to answer the following clinical question: "What is the influence of different suture techniques (continuous versus interrupted) and types of threads (non-absorbable versus long-lasting absorbable, preferably monofilament) on the development of IH in patients undergoing abdominal wall closure?".

The search was conducted between July and August 2024. The eligibility criteria defined were: studies had to be fully published, in English or Portuguese, from 1983 to 2024, indexed in the databases previously specified, and aligned with the topic of interest. All studies that did not meet the eligibility criteria, such as those published outside the temporal range, in other languages, or incomplete, were excluded from the selection, as well as trials conducted using animals and duplicate studies due to indexing in more than one database. Search results are summarized in the flowchart in Figure 1. Of the 38 articles selected through descriptor combinations, 22 were selected for full-text reading and only 9 were included in the systematic review.

Figure 1 - Article search flowchat



Source: own authorship

RESULTS

In the present study, 9 articles were selected based on the eligibility criteria previously defined. Together, these articles provided a sample of 5612 patients who underwent different suture techniques for abdominal wall closure using various suture materials. Due to the large sample size, an in-depth analysis was possible regarding potential complications and the incidence of incisional hernias after the use of a given technique and the suture material employed.

In the development of the results, continuous and interrupted suture techniques were highlighted, in addition to introducing the sutures used in patients undergoing abdominal wall closure, which include polypropylene (Prolene®), polyglycolic acid (Dexon®), stainless steel, polyglactin, polydioxanone, nylon, polyglyconate (Maxon®), polyglactin 910 (Vicryl®), PDS®, and Monoplus®.

For better understanding and visualization of the different suture techniques analyzed during abdominal wall closure and the suture materials employed, two tables were organized to present the examined studies.

Table 1 presents the analyzed studies, year of publication, number of patients, and associated complications such as wound infection, dehiscence, and local pain. It is noteworthy that the incidence of infectious complications was present in almost all studies, ranging between 4.1% and 16%.

Table 1 - Studies analyzed according to year of publication, number of patients, and associated complications.

Study	Year	Number of patients	Complications
Richards et al.[12]	1983	571	Suture abscesses (continuous), dehiscence
McNeil & Sugerman[13]	1986	105	Wound dehiscence, subcutaneous infection (2 in continuous group), seroma (1 in continuous group)
Wissing et al.[16]	1987	1491	Wound pain (16.7% nylon), suture sinus (7.7% nylon)
Trimbos et al.[15]	1992	340	Suture fistula and wound pain similar between techniques
Sahlin et al.[14]	1993	988	Infection (10% continuous, 11% interrupted), dehiscence (1% in both)
Hsiao et al.[20]	2000	340	Wound infection (4.1% with no significant difference between groups)
Justinger et al.[19]	2012	1018	Wound infection (6.1% polyglactin and 11.9% polydioxanone)
Seiler et al.[18]	2009	635	Wound infections (16%), burst abdomen, postoperative pulmonary complication
Polychronidis et al.[17]	2023	124	No significant difference in infection or dehiscence between techniques

Source: Author's elaboration

Table 2 highlights the suture techniques, the materials used, and the incidence of IH. It is possible to identify that the continuous suture technique was most frequently employed, generally associated with slowly absorbable monofilament threads such as polydioxanone, polyglyconate, and polyglactin. The IH rates varied widely, with emphasis on higher values in studies that used polyglactin (up to 20.6%) and lower rates in studies using nylon (10.3%) or polyglyconate (3%).

Table 2 - Studies analyzed according to suture techniques, suture material, and incidence of IH.

Study	Suture techniques	Suture material	Incisional hernia
Richards et al.[12]	Continuous	Polypropylene (Prolene®)	2,0%
	Interrupted	Polyglycolic acid (Dexon®)	0,5%
		(Dexon®)	
McNeil & Sugerman[13]	Continuous	Polyglycolic acid	9,8%
	Interrupted	Stainless steel	9,3%
Wissing et al.[16]	Continuous	Polyglactin	20,6%
	Continuous	Polydioxanone	13,2%
	Continuous	Nylon	10,3%
	Interrupted	Polyglactin	16,9%
Trimbos et al.[15]	Continuous	Polyglyconate	3%
	Interrupted	Polyglactin 910	4%
Sahlin et al.[14]	Continuous	Polyglyconate (Maxon®)	8,0%
	Interrupted	Polyglactin 910 (Vicryl®)	6,0%
Hsiao et al.[20]	Continuous	Polydioxanone (non-malignancy)	4,2%
	Continuous	Polyglactin 910 (non-malignancy)	2,6%
	Continuous	Polyglactin 910 (malignancy)	4,7%
Seiler et al.[18]	Continuous	PDS®	8,4%
	Continuous	Monoplus®	12,5%
	Interrupted	Vicryl®	15,9%
Polychronidis et al.[17]	Continuous	Monoplus®	27,1%
	Interrupted	Vicryl®	30,0%

Source: The authors

DISCUSSION

The analysis of the studies included in this review demonstrates that the continuous suture technique, when compared with the interrupted technique, presents a consistent advantage in terms of reducing operative time, without thisimplying a significant increase in postoperative complications such as dehiscence or IH. Richards et al.,[12] McNeil and Sugerman[13] and Sahlin et al.[14] demonstrated that the saving of minutes during closure, although seemingly modest, may

have important repercussions, especially in the context of prolonged surgeries or in patients with higher anesthetic risk, in whom each reduction in surgical time may translate into meaningful clinical benefits. This finding reinforces the idea that operative efficiency should be considered not only in terms of logistics but also as an element that may directly impact the morbidity associated with the procedure.

The study by Trimbos et al.[15] reinforces this perspective by showing that continuous suturing not only provides greater speed but also uses a smaller amount of residual material, which may reduce long-term complications such as chronic pain and persistent inflammation. This finding is directly connected to the results of Wissing et al.,[16] who observed a higher incidence of pain and suture sinus with non- absorbable threads, suggesting that both the quantity of material and its structural characteristics may be decisive for the patient's postoperative experience. Thus, Trimbos et al.[15] expands the understanding that the choice of technique may influence not only intraoperative efficiency but also medium- and long-term quality of life.

In the emergency setting, the study by Polychronidis et al.[17] adds a relevant aspect: although it did not identify statistically significant differences in the incidence of IH or fascial dehiscence between continuous and interrupted suture, it confirmed that the continuous technique is associated with shorter closure time, even in critical situations. This result converges with the findings of Richards et al.[12] and the multicenter study by Seiler et al.,[18] indicating that the operative efficiency of the continuous technique is maintained in different contexts, including in conditions of greater complexity, in which agility may directly impact clinical evolution and morbidity and mortality.

Regarding suture materials, the findings are more heterogeneous but allow for some consistent conclusions. Wissing et al.[16] and Justinger et al.[19] suggest that long- lasting absorbable sutures, such as polydioxanone, provide greater tensile support and are associated with lower IH rates compared with rapidly absorbable sutures such as polyglactin 910. Hsiao et al.[20] add that this benefit becomes even more evident in patients with greater tissue fragility, such as those with malignant neoplasms, in whom healing may be impaired. Thus, the choice of suture material is no longer merely a matter of technical preference, assuming instead a strategic role according to the patient's profile and the clinical context.

On the other hand, although non-absorbable sutures threads, such as nylon, present reduced IH rates, the studies point to a higher incidence of chronic pain and local complications, including suture sinus. This finding, observed in Wissing et al.,[16] contrasts with the results of Trimbos et al.,[15] which indicate that reducing the amount of residual material, when associated with the continuous technique, may mitigate such complications. This suggests that the balance between mechanical strength and long-term quality of life should be carefully considered. The impact of these chronic complications, often overlooked in short-term studies, deserves to be explored in future investigations that incorporate outcomes related to patient functionality and quality of life.

Another crucial point revealed by the review is the variability of outcomes when analyzed across different centers, as demonstrated in the multicenter INSECT study conducted by Seiler et al.[18] Even in the presence of similar protocols regarding technique and suture choice, the IH rate varied widely between institutions, from 0% to 25.5%. This finding highlights the relevance of factors not only technical but alsohuman and institutional, such as the surgeon's learning curve, the standardization of closure, and even organizational aspects related to perioperative care. Regardless of the material used, the quality of execution and adherence to closure protocols appear to play a decisive role in preventing complications.

Based on these findings, it is possible to derive hypotheses for future research anchored in the reviewed results themselves. The identification of advantages of polydioxanone in terms of prolonged tensile strength (Hsiao et al.;[20] Justinger et al.)[19] and of triclosan-coated polyglactin 910 in infection prevention (Justinger et al.)[19] suggests the need for the development of hybrid sutures that combine slow absorption, a monofilament structure, and antimicrobial properties. Likewise, the findings of Wissing et al.[16] and Trimbos et al.[15] regarding pain and inflammation resulting from excess residual material indicate that sutures impregnated with bioactive agents that promote tissue remodeling could reduce the chronic inflammatory response. Moreover, the observation that high-risk patients (for example, obese individuals, those with malignancy, or those undergoing emergency laparotomy) present higher rates of IH even with appropriate techniques (Hsiao et al.;[20] Polychronidis et al.;[17] Seiler et al.)[18] supports the investigation of the association between long-lasting sutures and the prophylactic use of mesh in this subgroup.

Additionally, large-scale multicenter clinical trials stratified by variables such as obesity, the presence of malignancy, immunosuppression, and type of surgery are needed to more robustly clarify the interaction between technique, material, and patient profile. The use of multivariate statistical models could help identify independent predictors for the development of incisional hernias, providing support for personalized abdominal closure protocols.

In summary, this review shows that the decision between continuous or interrupted suturing, as well as between absorbable or non-absorbable suture materials, should not be guided by a single outcome or isolated study. The integrated analysis of the studies demonstrates that the choice between continuous and interrupted suturing techniques, as well as the selection of the type of suture material (whether slow- or fast-absorbing absorbable sutures, or non-absorbable ones), must be carefully individualized. While the continuous technique often stands out for reducing operative time, different suture materials present distinct profiles regarding tensile strength, infection, and late complications. The presence of risk factors, such as malignancy and obesity, highlights the importance of tailoring the surgical approach to the patient's profile, whereas slow-absorbing sutures such as polydioxanone appear to offer greater safety in these high-risk patients. However, factors such as surgeon experience, technical standardization, and patient characteristics remain decisive in determining the final outcome. Advancing knowledge in this field depends on an integrated perspective that, moving beyond the comparison between techniques and materials, also incorporates an understanding of the complex interaction between wound-healing biology, surgical practice, and technological innovation.

CONCLUSION

In summary, this review demonstrates that the decision between continuous or interrupted suturing, as well as between absorbable or non-absorbable threads, should not be guided by a single outcome or isolated study. The integrated analysis of the studies shows that the choice between continuous and interrupted suture techniques, as well as the selection of the type of suture material (whether slow- absorbing or fast-absorbing, or non-absorbable), must be carefully individualized. While the continuous technique often stands out for reducing operative time, different suture materials present distinct profiles of resistance, infection, and late complications. The presence of risk factors, such as malignancy and obesity, highlights the importance of adjusting the surgical

approach to the patient profile, while slow-absorbing sutures, such as polydioxanone, seem to offer greater safety in these high-risk patients. However, factors such as surgeon experience, technical standardization, and patient profile remain decisive in defining the final outcome. The advancement of knowledge in this area depends on an integrated view that, starting from the comparison between techniques and materials, also incorporates the understanding of the complex interaction between wound-healing biology, surgical practice, and technological innovation.

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