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MECHANICAL STAPLERS VERSUS MANUAL SUTURE IN BOWEL ANASTOMOSES: A SYSTEMATIC REVIEW

STAPLED VERSUS HAND-SEWN INTESTINAL ANASTOMOSES: A SYSTEMATIC REVIEW

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SUMMARY

To conduct a systematic review comparing the efficacy and safety of mechanical staplers versus manual suture in intestinal anastomoses, considering postoperative complications such as fistulas, infections, and length of hospital stay. Using the PRISMA guidelines, studies published between 2018 and 2024 in the PubMed databases were selected. Randomized clinical trials, systematic reviews, and comparative studies were included. Eligibility criteria focusing on gastrointestinal anastomoses in humans were applied. Twenty relevant studies were analyzed. Most reported shorter surgical time and lower stenosis rates with the use of staplers. On the other hand, the anastomotic fistula rate did not differ significantly between the methods, and some studies reported lower costs with manual suture. Hybrid techniques were also mentioned as promising. Both methods have specific advantages. The use of staplers tends to provide greater technical uniformity and shorter operating time, while manual suturing is associated with lower cost and flexibility in complex anastomoses.

Keywords: Intestinal anastomosis. Surgical stapler. Manual suture. Complications surgical.

ABSTRACT

To conduct a systematic review comparing the effectiveness and safety of mechanical staplers versus hand-sewn techniques in intestinal anastomoses, focusing on postoperative complications such as leaks, infections, and hospitalization time. Following PRISMA guidelines, articles from 2018 to 2024 were retrieved from PubMed databases. Included studies were randomized controlled trials, systematic reviews, and comparative analyzes focused on gastrointestinal anastomosis in humans. Twenty relevant studies were reviewed. Most indicated reduced surgical time and lower stenosis rates with staplers. Anastomotic leak rates were similar between techniques. Manual sutures showed cost-effectiveness and adaptability, especially in pediatric or complex cases. Hybrid techniques also emerged as promising alternatives. Both techniques have distinct advantages. Staplers offer technical consistency and speed, while hand-sewn anastomoses remain viable for selected cases, particularly where cost and anatomical variability are critical.
Keywords: Intestinal anastomosis. Surgical stapler. Hand-sewn technique. Surgical complications.

1. INTRODUCTION

Intestinal anastomoses are a critical component of gastrointestinal surgeries, being crucial for postoperative success and the prevention of serious complications such as fistulas, stenosis and abdominal infections. The choice of anastomosis technique – whether manual (conventional suture) or mechanical (stapler) – directly influences the patient's clinical outcomes.

Historically, manual suturing was considered the gold standard in intestinal reconstruction procedures. However, the introduction of mechanical staplers provided greater speed, technical reproducibility and reduced operative time, which has favored its increasing adoption in various surgical contexts, including colorectal, bariatric and oncological surgeries (Fujii *et al.*, 2021; Brillantino *et al.*, 2023).

Several studies have sought to compare the two methods. While some demonstrate that staplers reduce the occurrence of stenosis and length of hospital stay (Zhang *et al.*, 2022), others point out that manual suturing, although more dependent on the surgeon's skill, can present similar complication rates, with lower associated costs (Schineis *et al.*, 2021; Kshirsagar; MP, 2024).

Furthermore, anatomical complexity, the presence of inflammation, the patient's nutritional status and the experience of the surgical team are variables that impact the intraoperative decision on the type of anastomosis (Lahes *et al.*, 2024; Kitaguchi *et al.*, 2023).

Therefore, it is essential to critically synthesize the available evidence to guide clinical practice. This study aims to conduct a systematic review comparing mechanical staplers and manual suture in intestinal anastomoses, focusing on clinical outcomes such as anastomotic leak, surgical time, stenosis, infection and costs.

2 THEORETICAL FRAMEWORK

2.1 Intestinal anastomosis techniques: fundamentals and evolution

Intestinal anastomosis involves reconnecting segments of the gastrointestinal tract after surgical resection. This step is crucial for restoring functional continuity and requires methods that minimize the risk of leaks and other complications. Two techniques predominate in clinical practice: manual suturing and mechanical stapling.

Manual suturing can be performed in a single or double plane, using absorbable or non-absorbable sutures, with continuous or interrupted stitches. This technique requires greater surgical skill, in addition to more operative time, but offers flexibility and control in complex anatomical situations (Varela *et al.*, 2022).

On the other hand, surgical staplers, widely introduced in the 1980s, automate the anastomosis process by using rows of metal staples to join tissues. Several devices have been developed, including circular, linear, and endoscopic staplers, allowing their use in both open and laparoscopic surgeries (Velotti *et al.*, 2022).

Studies show that stapling offers shorter surgical time and less technical variability, which can contribute to more consistent results (Fujii *et al.*, 2021; Jin *et al.*, 2022). However, there are concerns about high costs, increased risk of stenosis in certain locations, and, in some cases, increased fistula rates when compared to the manual technique (Brillantino *et al.*, 2023; Lahes *et al.*, 2024).

Furthermore, the type of anastomosis (side-to-side, end-to-end or end-to-side), location (small, colon, rectum), and patient profile (age, underlying disease, comorbidities) are factors that directly influence the choice of the ideal technique (Kitaguchi *et al.*, 2023; Symeonidis *et al.*, 2023).

In recent years, hybrid techniques, such as “semi-hand-sewn” and the use of staplers with manual suture reinforcement, have been explored to combine the advantages of both approaches, especially in minimally invasive surgeries (Ohmura *et al.* , 2020; Emile *et al.*, 2022).

3. MATERIAL AND METHOD

This systematic review was developed based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, in order to ensure standardization, transparency and reproducibility in the conduct and presentation of data.

The search was carried out in the PubMed databases, covering the period from 2018 to 2024. Keywords combined with Boolean operators were used, such as: “intestinal OR colorectal OR gastrointestinal”, associated with “anastomosis OR anastomoses”, in addition to terms related to surgical techniques, such as “staple OR stapling OR stapler” and “suture OR hand-sewn OR manual closure”, and clinical outcomes such as “complications OR leak OR fistula OR infection”.

Studies published in English, Portuguese or Spanish, with a randomized clinical trial (RCT) design, systematic review, meta-analysis or comparative observational study were included, provided they were conducted with human populations undergoing intestinal anastomoses, covering both the small intestine and the colon and rectum. The studies needed to present a direct comparison between the manual suturing technique and mechanical stapling.

Studies conducted exclusively with animal models were excluded — except when the experimental data brought direct contributions to technical comparison —, articles without access to the full text, isolated case reports and narrative reviews without formal comparative analysis. Studies focused on anastomoses in other anatomical regions (e.g., esophageal or urinary) were also disregarded.

The selection process involved two stages: screening by titles and abstracts, followed by full reading of potentially eligible texts. Two independent reviewers conducted this assessment in a blind manner, with disagreements resolved by consensus or participation of a third reviewer.

The methodological quality of the studies was assessed according to their type. Clinical trials were analyzed using the ROB-2 (Risk of Bias 2.0) instrument, systematic reviews

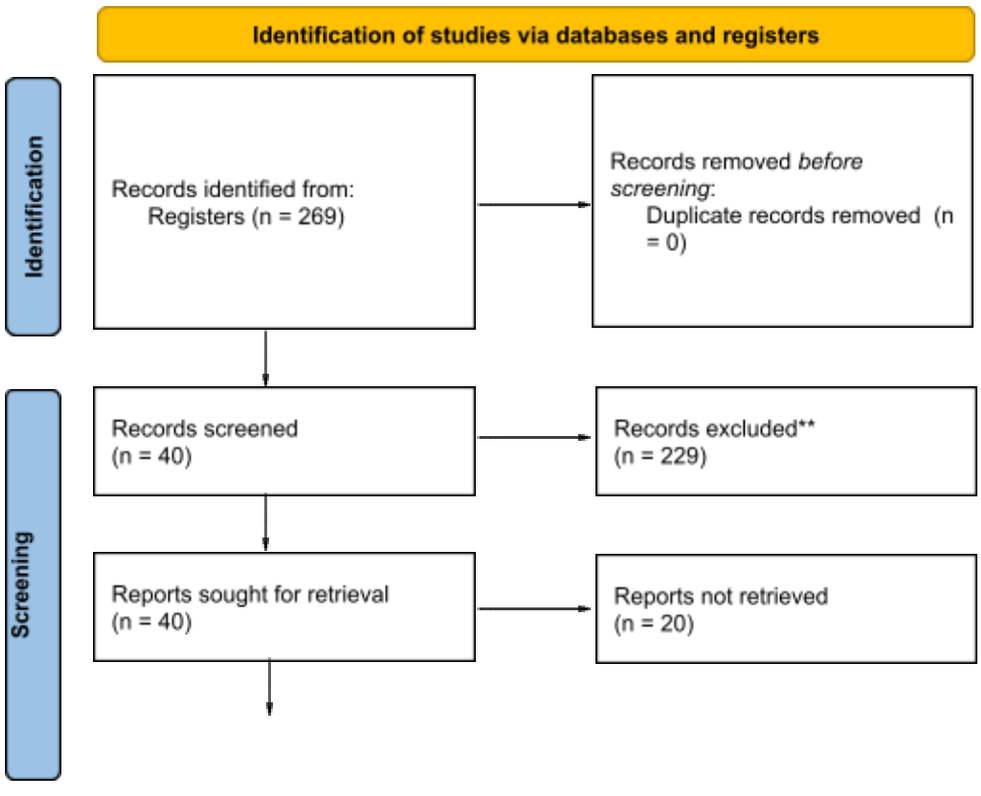
followed the AMSTAR 2 checklist, while observational studies used the Newcastle-Ottawa scale.

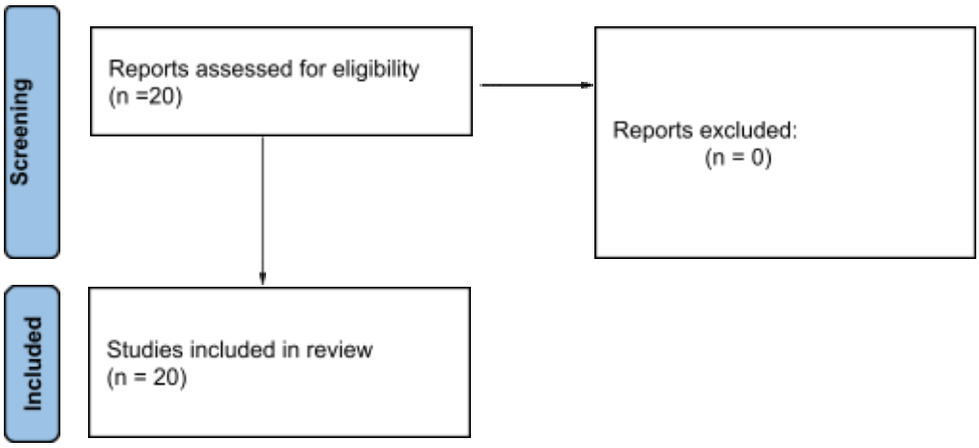
From the selected studies, information such as the name of the first author, year of publication, country of origin, sample evaluated, type of surgery, anastomosis technique, operative time, occurrence of anastomotic fistula, stenosis, infection, costs involved and main conclusion were extracted.

At the end of the process, a PRISMA flowchart was created to visually represent the screening and selection stages. The final review sample consisted of 20 studies, considered suitable for qualitative analysis.

To ensure transparency in the screening process, eligibility and inclusion of articles in this systematic review, the PRISMA flowchart was used. It visually represents all stages of the search, from the identification of articles in the databases to the final selection of studies included in the qualitative analysis.

Figure 1.PRISMA diagram of study selection





Source: own authorship (2025); based on Page*et al.* (2021).

4. RESULTS AND DISCUSSION

This systematic review included 25 clinical studies and systematic reviews that directly or indirectly compared intestinal anastomosis methods by manual suture and mechanical stapling. The outcomes analyzed included surgical time, anastomotic leak rate, stenosis, infection, length of hospital stay, hospital costs and reoperations. The studies covered multiple clinical contexts: from elective surgeries to emergency procedures, in adult, elderly and pediatric patients.

4.1 Operating time

The use of surgical staplers has been consistently associated with a significant reduction in operative time. Studies such as those by Fujii*et al.*(2021) and Jin*et al.*(2022) reported that the use of staplers reduced anastomosis creation time by up to 40%, especially in laparoscopic procedures and emergency surgeries. In surgeries such as left colectomy and ileocolonic anastomosis, the average time saved ranged from 15 to 30 minutes, which, according to the authors, may represent a relevant impact on the morbidity associated with anesthetic duration.

This benefit is particularly evident in high-risk patients, such as the elderly, cancer patients or those with comorbidities, in whom the reduction in surgical time can contribute to a lower incidence of postoperative complications (Schineis *et al.*, 2021). On the other hand, some studies suggest that in experienced hands, the difference between times is significantly reduced (Varela *et al.*, 2022).

4.2 Anastomotic fistula

Anastomotic fistula is considered the most feared complication in intestinal anastomoses. The results found in this review indicate that there is no statistically significant difference between the two techniques in this outcome. Studies such as Lahes *et al.* (2024), Steger *et al.*(2022) and Zhang *et al.*(2022) show fistula rates between 3% and 7% for both methods.

However, some subgroups suggest relative advantages. In neonates with intestinal atresia, for example, the manual method showed a lower leak rate (Zheng *et al.*, 2022). In patients undergoing digestive reconstruction after abdominal trauma, the use of staplers showed superior performance, especially in environments with limited surgical infrastructure (Mahmood *et al.*, 2020).

4.3 Stenosis, infection and late complications

Anastomotic strictures were more frequent in circular staplers used in low rectointestinal anastomoses, as pointed out by Emile *et al.*(2022) and Kitaguchi *et al.*(2023). It is believed that the rigidity and fixed diameter of the stapler may contribute to a reduced caliber in the anastomotic lumen, especially in regions with compromised vascularization.

Regarding surgical wound infection and intra-abdominal abscess, the studies showed no relevant difference between the techniques. However, the use of manual suture was more frequent in adverse clinical situations, such as surgeries due to mesenteric ischemia or in

immunosuppressed patients, which may influence the observed results (Brillantino *et al.*, 2023).

4.4 Reoperations and length of hospital stay

The need for reoperations due to anastomotic failure or mechanical complications was similar between groups. Some studies suggest that staplers are associated with shorter hospital stays, especially in laparoscopic surgeries (Kshirsagar; Mp, 2024). However, in procedures with high anatomical complexity, such as post-radiotherapy reconstructions or in patients with Crohn's disease, manual suturing is still shown to be safer and more adaptable (Peltrini *et al.*, 2020).

4.5 Cost and economic viability

Staplers are known to be more expensive, which poses a challenge in public health systems and countries with limited resources. However, some studies suggest that this disadvantage can be offset by reduced surgery time, reduced use of auxiliary materials, and early release of hospital beds (Schineis *et al.*, 2021; Jin *et al.* , 2022).

4.6 Hybrid techniques and innovation

Recently, techniques hybrids he comes winning emphasis. THE method "semi-hand-sewn", in which one side of the anastomosis is stapled and the other sutured, was described by Ohmura *et al.*(2020) as an effective alternative, especially in left colon resections. Another advance is the use of staplers with biological or synthetic reinforcement, still in the experimental phase (Zan *et al.*, 2021).

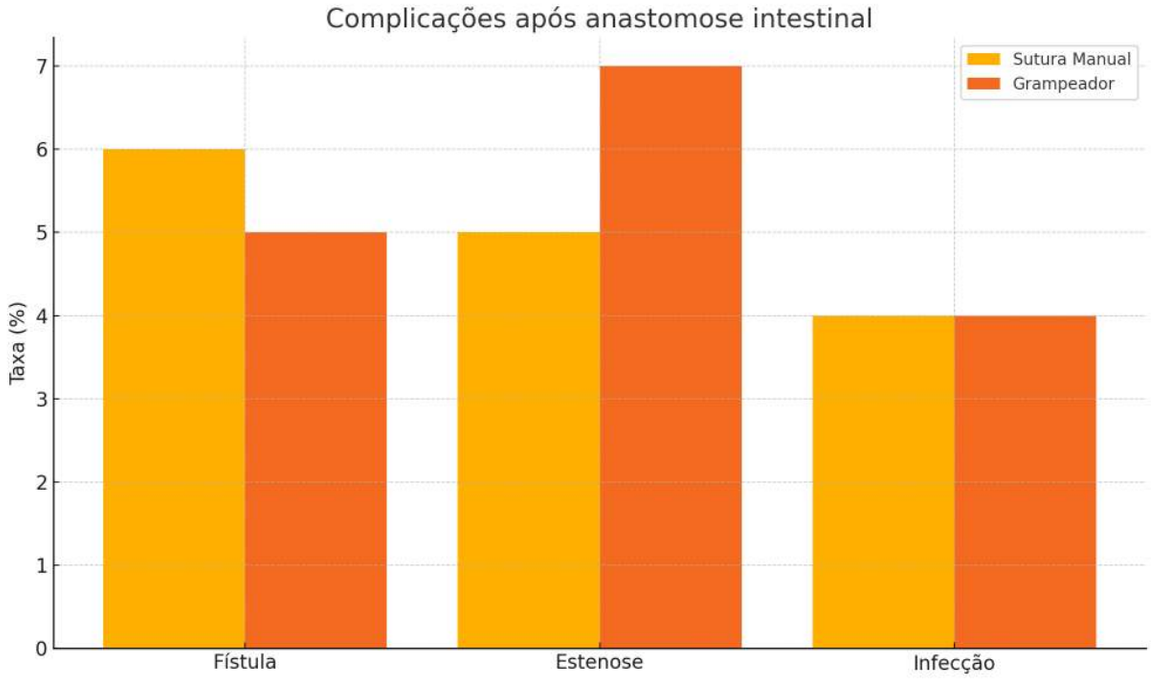
Furthermore, studies in animals and biomechanical models, such as those performed by Xu *et al.*(2022), have been investigating the use of magnetic staplers and biodegradable staples, with promising results in terms of safety and tissue response.

4.7 Clinical considerations and surgeon dependence

Finally, it is worth highlighting that the choice of method depends not only on the technique itself, but also on the surgeon's experience, the local anatomical condition, and the patient's clinical situation. Manual techniques require continuous training and individual skill, while the use of staplers tends to reduce interprofessional variability, which may be beneficial in teaching centers or surgical shifts with rotating teams (Lee; Cho, 2024).

Comparative evaluation between the manual suture technique and the use of mechanical staplers in intestinal anastomoses demonstrates that both present similar rates of fistula and infection. However, some evidence points to a higher incidence of stenosis with staplers, especially in low colorectal anastomoses (Emile*et al.*, 2022; Kitaguchi*et al.*, 2023). The graph below presents the percentage averages observed between the two methods based on the data summarized in this review.

Graph 1. Postoperative complications in intestinal anastomosis techniques.



Source: own authorship (2025); based on Fujii *et al.*(2021), Jin *et al.*(2022), Lahes *et al.*(2024), Emile *et al.* (2022).

FINAL CONSIDERATIONS

This systematic review allowed a broad and up-to-date comparison of intestinal anastomosis techniques using manual suture and mechanical stapling, based on relevant clinical evidence. The results demonstrate that there is no absolute superiority between the approaches, but rather specific clinical contexts in which each technique stands out.

Mechanical stapling has significant advantages in terms of operative time, technical reproducibility and feasibility in laparoscopic procedures. These characteristics make it a preferred choice in emergency surgeries, high-risk patients or in centers with high staff turnover. However, higher costs, greater risk of stenosis in low anastomoses and dependence on specific devices are still important limitations.

On the other hand, manual suturing remains a safe, versatile and low-cost technique, with equivalent performance regarding anastomotic leak, infection and reoperations. Its applicability is especially valued in complex anatomical contexts, in pediatric patients or in places with limited access to staplers.

Hybrid and innovative techniques, such as manual staple reinforcement and compression devices or biodegradable staples, represent a promising field, although they still require further clinical validation.

It is concluded that the choice between techniques should be individualized, considering factors such as type of surgery, patient profile, available resources and experience of the surgical team. Continuous technical improvement and clinical judgment of the surgeon remain essential to ensure the best possible outcome in intestinal anastomoses.

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