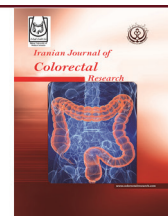


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Exploring the Use of Skin Staples for Bowel Anastomosis: A Scoping Review

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Abstract

Background: Intestinal staplers have revolutionized gastrointestinal surgery by facilitating faster bowel anastomoses, achieving outcomes comparable to hand-sewn techniques. However, their high cost restricts routine use in resource-limited settings, leading to increased interest in using skin staples for bowel anastomoses. Therefore, we aim to evaluate the use of skin staples for this purpose.

Methods: We conducted a systematic search of databases using the search terms “skin staples” and “bowel anastomoses.” Studies that focused on the use of skin staples for bowel anastomoses were included, while abstracts, animal studies, and conference papers were excluded. The risk of bias was assessed with the ROBINS-I tool.

Results: Two non-randomized studies involving 115 patients met the inclusion criteria. The majority of cases involved small bowel-to-small bowel anastomoses (74.8%), with cancer being the primary indication (80%). Postoperative complications included two cases of pelvic collections and one case of intestinal obstruction, all of which were managed non-operatively. No anastomotic leaks were reported. The risk of bias was moderate due to unclear patient selection processes.

Conclusion: While the use of skin staples for bowel anastomoses appears to be safe, with no reported anastomotic leaks and minimal complications in the included studies, it is important to note the small sample sizes of these studies. This highlights the need for further multicenter randomized controlled trials to validate these findings and compare outcomes with conventional staplers and hand-sewn methods. The potential of skin staples as a viable alternative in resource-limited settings is promising; however, further research is necessary to confirm this.

Keywords: Surgical anastomosis; Surgical stapling; Postoperative complications

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Introduction

The widespread use of intestinal staplers for bowel anastomoses has been practiced since the 1960s, when Ravitch and Steichen modified the stapling devices acquired from the Soviet Union (1). These devices revolutionized gastrointestinal surgery by reducing operation times and achieving outcomes comparable to traditional hand-sewn anastomoses (2, 3). Despite their success, the adoption of intestinal staplers in developing countries has been limited, primarily due to their high costs (4), which range from \$400 and \$800. This price range makes them unaffordable for many healthcare systems and patients in low-income settings (5). The high cost is further compounded by limited purchasing power in many developing countries, where a significant percentage of the population earns less than \$1 daily (6, 7). Furthermore, a lack of exposure to and training in the use of staplers among surgeons in these regions has hindered their widespread adoption (5). Additionally, the lack of universal health insurance coverage exacerbates the inaccessibility of these devices (8). In response to these challenges, there is growing interest in using skin staplers for bowel anastomoses.

Establishing the benefits of using skin staplers for bowel anastomoses may enable surgeons to overcome these challenges. An animal study (9) has demonstrated that skin staplers facilitate rapid inversion and apposition of bowel walls and are easy to learn. Additionally, the tensile strength of these anastomoses is comparable to traditional hand-sewn techniques (10). While these findings are promising, a comprehensive analysis of complications associated with human skin staplers is necessary. Such a review could determine whether this approach is non-inferior to intestinal staplers and may serve as a basis for designing multicenter randomized controlled trials to compare the two methods of bowel anastomoses. The routine use of skin staplers for bowel anastomoses has the potential to promote faster surgeries, especially in laparotomy for trauma, making it a practical and cost-effective alternative for routine bowel anastomoses, especially in resource-limited settings (11). By identifying the potential risks and benefits associated with the use of skin staplers for bowel anastomoses, there may be a reformation of surgical care, particularly in emergency settings. Therefore, this review aims to identify the current evidence regarding the use of skin staplers for bowel anastomoses.

Methods

The study aimed to address the research question:

What is the current evidence regarding the use of skin staplers for bowel anastomoses in humans? The outcomes assessed included the indications for surgery, as well as the morbidity and mortality associated with the use of skin staplers for bowel anastomoses. This scoping review was registered on the Open Science Framework (<https://doi.org/10.17605/OSF.IO/KZPRB>) (12). It was also conducted in accordance with the PRISMA-ScR guidelines (13).

The PubMed gateway, Google Scholar search engine, and the Cochrane database were searched. Additionally, we manually reviewed the references of some of the extracted manuscripts. The last search was conducted on February 18, 2025. We included all studies published since 1980, regardless of language.

Search Strategy

The primary search terms used were “skin staplers” and “bowel anastomoses”. Table 1 for the search terms used for the PubMed gateway.

Study Selection And Data Collection Process

The studies derived from the Cochrane database, PubMed gateway, and Google Scholar search engine were imported into Rayyan software (14). The two authors (S.O., L.A., and A.A.) selected and removed duplicate entries. They conducted individual screenings, followed by a joint review to resolve any disagreements. Reconciliation was achieved by referring to the inclusion and exclusion criteria.

Using the inclusion criteria, the authors extracted the following information from the included studies and organized it into an Excel spreadsheet: the first author's name, publication year, and the country where the study was done. Additional information extracted included the number of study participants, indications for bowel resection, the type of bowel anastomosed, surgical complications, and the causes of mortality.

Inclusion and Exclusion Criteria

Inclusion criteria were the studies on the use of skin staplers for bowel anastomoses in humans.

Exclusion criteria comprised abstracts, animal studies, and conference papers.

Risk of Bias Assessment

The risk of bias was evaluated using the ROBINS-I tool by authors S.O. and A.A (15). Results were visualized with a Robvis plot, which generated summary and traffic plots (16).

Data Analysis

Data analysis was conducted using percentages.

Table 1: The search terms used in the PubMed gateway

PubMed Search terms

(“skin staplers” OR “dermal staplers” OR “cutaneous staplers”) AND (“bowel anastomosis” OR “intestinal anastomosis” OR “gastrointestinal anastomosis” OR “Anastomosis, Surgical”[Mesh] OR “Intestines/surgery”[Mesh])

Results

The search yielded 355 articles from all the databases and manual searches. After removing five duplicates, a total of 348 articles remained, of which two studies (11, 17) met the inclusion criteria. Both studies were non-randomized.

The risk of bias in the included studies was assessed using the ROBINS-I tool. Both studies were found to have a moderate risk of bias due to the lack of information regarding the inclusion of consecutive patients. All other domains of bias were considered to pose a low concern in both studies (Figures 1A and 2B).

The total number of patients across the two studies was 115. The most common indication for surgery was cancer, accounting for 80% of the cases. The

most frequently performed type of anastomosis was small bowel to small bowel, comprising 74.8% of the procedures (Tables 2 and 3). Postoperative complications included two cases of pelvic collections, which were clinically insignificant and did not require drainage. Additionally, one patient developed an intestinal obstruction, which was managed non-operatively.

No anastomotic dehiscence was reported in any of the included studies. However, two patients died during the postoperative period. One death was attributed to a cerebrovascular accident, while the cause of death for the second patient was not disclosed.

Discussion

This scoping review demonstrates no instances

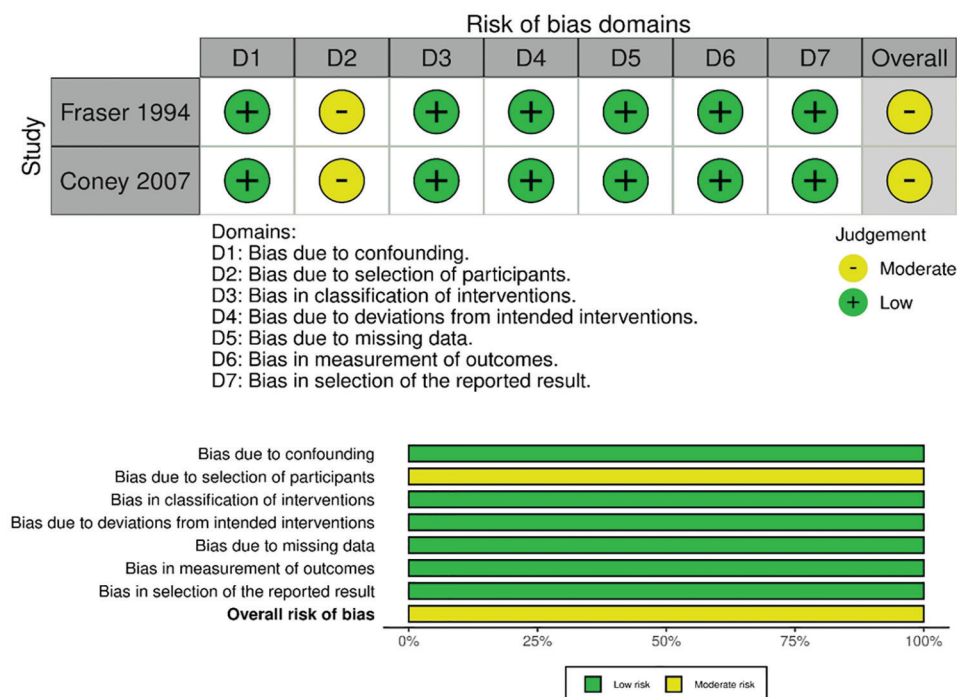


Figure 1: a) The traffic plot of the risk of bias for the included study. b) The summary plot of the risk of bias.

Table 2: The indication for using skin staples for bowel anastomosis.

Indication for Surgery	Value N (%)
Cancer	92 (80)
Crohn's disease	9 (7.8)
Diversion for non-malignant disease	4 (3.5)
Adhesive small bowel obstruction	4 (3.5)
Correction of ileal loop complication	3 (2.6)
Colostomy closure	1 (0.9)
Irradiation stricture	1 (0.9)
Ileal conduit	1 (0.9)

Table 3: The type of bowel anastomosis.

Type of bowel anastomosis	Value N (%)
Small bowel to small bowel	86 (74.8)
Small bowel to Colon	21 (18.3)
Colon to colon	3 (2.6)
Colon to rectum	6 (5.2)

of anastomotic leaks and minimal complications when skin staples are used for bowel anastomoses. Therefore, they may serve as a suitable alternative to hand-sewn techniques or conventional staplers, especially in resource-limited settings.

Intestinal staplers have opened a new horizon in gastrointestinal surgery by facilitating faster procedures with a reduced risk of complications. They can reduce the waiting times for surgery, particularly in developing countries where the lack of available operating room space is a significant contributor to preoperative delays for emergency laparotomies (18).

There were no anastomotic leaks, a significant concern in gastrointestinal surgery, among the 115 patients who underwent bowel anastomoses using skin staples. The lower rate of anastomotic leaks may be attributed to the effective inversion of the bowel edges achieved with skin staples, as well as the uniform tissue compression they provide across the edges of the bowel (19).

There were no other significant postoperative complications noted, aside from two cases of pelvic collections and one case of intestinal obstruction, which were managed non-operatively. The absence of anastomotic leaks in the reviewed studies is consistent with existing evidence highlighting the importance of uniform compression and proper tissue inversion during anastomoses (11).

Compared to hand-sewn anastomosis, with variations in knot security and tension among surgeons, skin staplers could eliminate these potential risk factors for anastomotic leaks. Furthermore, the simplicity and rapidity of this technique make it a promising option in emergency settings, where time is critical.

The high cost of intestinal staplers in developing countries has prompted the consideration of more affordable alternative methods for bowel anastomoses, with skin staples being considered a cost-effective alternative. However, there is currently no substantial evidence directly comparing the effectiveness and safety of skin staples to intestinal staplers in this context. In developed countries, evidence has demonstrated that bowel resection with stapled anastomosis reduces both operational and hospital costs compared to hand-sewn techniques (20).

Extrapolating from these findings, the routine use of skin staples for bowel anastomoses might further reduce the operational costs. However, this claim

remains speculative at best, as clinical trials are essential to compare skin staples with intestinal staplers and hand-sewn techniques, particularly regarding safety, complication rates, and costs.

With only 115 patients included across two non-randomized studies, the sample size is insufficient to conclude the safety of skin staples in humans. Additionally, the included studies exhibited a moderate risk of bias, as it remains unclear whether the consecutive patients were included. Furthermore, both studies lacked long-term follow-up data, which is crucial for assessing complications such as anastomotic strictures or delayed leaks. There is a need for future well-designed randomized studies to compare skin staples with hand-sewn and intestinal stapler anastomoses in terms of surgical duration and complication profiles. A significant shortcoming of this paper is the lack of images to illustrate the use of skin staples for bowel anastomosis.

Conclusion

This review highlights the relative safety and feasibility of performing bowel anastomoses using skin staples, demonstrating minimal complications and no anastomotic leaks. While these findings are encouraging, they should be interpreted with caution due to the small sample sizes of the two included studies. To provide more comprehensive data, we recommend conducting multi-center randomized clinical trials to directly compare the outcomes of skin staples with sutures and conventional staplers in bowel anastomoses. Additionally, there is a need to evaluate the cost-effectiveness of this approach in future studies.

Authors' Contribution

S.O. was involved in conceptualisation, literature search and drafting of manuscript. A.L. was involved in the drafting of manuscript and literature search. A.A. was involved in literature search and conceptualisation. All the authors were involved in writing and reviewing of the manuscripts.

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