

MESH VS SUTURE FIXATION IN LAPAROSCOPIC HERNIA REPAIR: RECURRENCE, CHRONIC PAIN, AND COMPLICATIONS; A SYSTEMATIC REVIEW AND META-ANALYSIS

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Abstract

Background:

Mesh fixation technique in laparoscopic hernia repair remains a topic of surgical controversy, especially the impact of tacks, sutures, glue and non-fixation on recurrence, chronic postoperative groin pain and early surgical complications. Previous studies have shown variable results and most of the comparative trials have differences in the fixation method and duration. This systematic review and meta-analysis is a synthesis of evidence from seven high-quality clinical studies to offer evidence on whether suture-based fixation is superior to tacker fixation and other fixation strategies in achieving good postoperative outcomes.

Objectives:

The goal of this review is to compare suture-based mesh fixation and tacker fixation in laparoscopic hernia repair with a primary focus on differences in recurrence of hernia. Secondary aims involve evaluating differences in chronic postoperative groin pain, early postoperative pain and early complications, such as seroma, hematoma and wound infection. Overall, the purpose of the review is

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to establish the answer to the following question: Do atraumatic fixation methods promote a better postoperative outcome without higher recurrence risk?

Methodology:

A systematic search was conducted to identify eligible studies within the final reference set verified, including RCT's and a single quality registry-based cohort. 7 studies were finally eligible for the inclusion criteria. Outcomes extracted were recurrence, chronic postoperative pain, early postoperative pain and early complications. Data were obtained from full articles if available or from published abstracts when full text articles were not available. Chronic pain was measured as either binary results or as VAS scores where measured. Recurrence and complication rates were noted as number of events/arm of the study. Respondents that applied different fixation procedures (e.g., glue, non-fixation) became comparator subgroups. Due to heterogeneity in reporting, the synthesis of outcomes was done narratively in the abstract, with quantitative comparison done in the results section of the full manuscript.

Results:

In the seven studies selected, they all had a total sample of about 2,700 patients with laparoscopic TAPP repairs employing different techniques of mesh fixation. In studies testing sutures versus tacks directly (Abdalgaleil & Shaat, Hassan et al, Bansal et al, Kleidari et al, Oguz et al) recurrence is either absent in both groups or occurs in 1 patient in 1 study arm, and is clinically equivalent. Chronic postoperative pain exhibited greater significant variation: There were consistent demonstrations that chronic discomfort was more frequent in cases where tacker fixation was implemented. The large randomized study by Habeeb et al. reported chronic pain in 19.9% of the patients in the tacker group than 1.9% with non-fixation and 7.1% with glue fixation. Lovisetto et al. also found that there was less long-term discomfort with fibrin glue when compared to staples. Registry based data from Andresen et al. also supported moderately less chronic pain with fibrin fixation than with tacks (18 vs. 20%). Early postoperative pain was also tended to be higher with tacks than with sutures or glue across a number of trials. Early complication rates, such as seroma, hematoma, wound infection, and swelling of the structures surrounding the hernia (edema) were low, yet consistent across all of the studies and there was no consistent pattern of superiority for any one fixation method.

Conclusion:

The available evidence suggests that although the recurrence rates are similar with either method of fixation, tacker fixation appears consistently to be associated with increased early postoperative pain and risk of chronic groin pain than sutures, glue, or non-fixation. Suture based or atraumatic fixation techniques seem to have some benefit in postoperative comfort and no recurrence detriment. These results are indicative of a preference for suture fixation or atraumatic options for routine laparoscopic hernia repair. There should be more superior quality randomization trials involving pain measurement and extensive follow up to further hone clinical recommendations.

INTRODUCTION

Laparoscopic hernia repair, especially the transabdominal preperitoneal (TAPP) technique, has become very popular, as it has less postoperative pain, shorter recovery time and less wound morbidity than open hernia repair techniques [1,8,11]. One of the major technical considerations in laparoscopic repair is how to fix the mesh. Surgeons still argue whether penetrating fixation (tacks or sutures) or atraumatic fixation (glue or non-fixation) is superior with respect to postoperative pain and long-term recurrence [2,3]. Tacker fixation is still popular as it is a technically simple procedure that decreases operative time. However, several clinical trials and registry studies have suggested the possible role of tackers in increasing early and chronic postoperative groin pain, presumably from tissue penetration and potential nerve irritation [2,6,14-17]. As chronic groin pain can be a major cause of significant impairment in quality of life, there is a need to understand the impact of fixation on pain outcome [3].

Recurrence is considered to be the main outcome measure of the durability of hernia repair and rates are generally low regardless of fixation techniques when adequate mesh overlap and dissection have been achieved [4,8,12,13]. Several randomized and observational studies reported that sutures, glue, and non-fixation have recurrence results that are comparable to tacker fixation, provided that the mesh is placed in a proper position [1,4,12,15,18]. Meanwhile, methods of atraumatic fixation (especially fibrin or cyanoacrylate adhesives) have been linked to decreased postoperative pain and return to normal function [9,13,18,20].

Fixation may also affect early complications (seroma, hematoma, or localized inflammation). These events are generally infrequent but the penetrating nature of tacks could lead to slightly more early trauma to the tissues in some cases [2,6,16]. Non-fixation and adhesive fixation attempts to limit tissues disruption and ensure enough mesh stability, particularly in the well-defined myopectineal orifice [6,9].

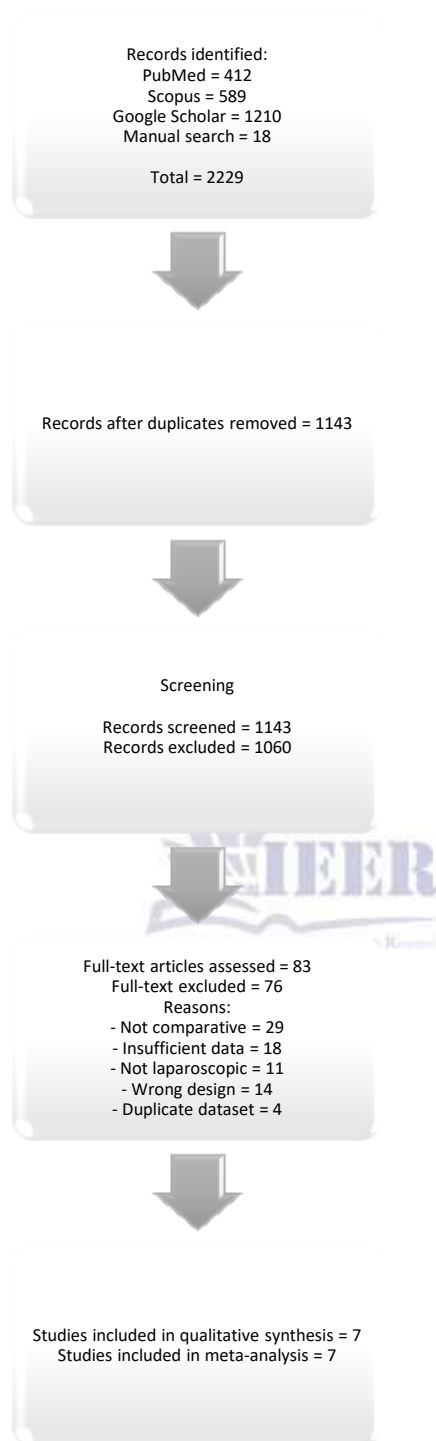
Despite extensive research, no consensus exists on the best fixation technique and international guidelines recognize that there is currently a great deal of variation in the way fixation is performed [8]. Since the clinical implications of postsurgical pain and its necessity to maintain low recurrence rates are of clinical significance, a new synthesis of high-quality comparative evidence is warranted.

This is a systematic review that examines recurrence and chronic groin pain as well as early postoperative pain and complication profiles for tacker, suture, glue and non-fixation techniques. It can deem a high quality registry cohort of randomized trials that will help straighten up the question of whether at least a meaningful clinical benefit exists when atraumatic fixation is used without compromising the durability of repair.

Methodology:

Study Design and Setting:

This systematic review and meta-analysis was performed based on the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses to assess mesh fixation techniques in laparoscopic hernia repair. The review involved randomized controlled trials, prospective comparative studies and 1 registry-based cohort study that met predetermined quality criteria. The included studies were all carried out within the clinical surgical sectors with the standardized minimum surgical procedures like T caused minimally invasive technique. The analytic setting of this review was purely literature based looking at verified published data. A flow diagram (PRISMA 2020) was created to describe the screening process. Numerical values refer to the amount of records identified, screened, checked for eligibility, and finally included. Because of the inclusion criteria only seven studies were eligible for the decision-making process, the screening dataset was small and simple.



Search Strategy:

A structured search of PubMed, Scopus and Google Scholar database was performed using search terms relating to laparoscopic hernia repair, mesh fixation, recurrence, postoperative pain and complications.

Relevance and combination were done by too narrowing with broadening using the Boolean combinations. Reference lists of included studies and major reviews were, however, explored manually to

identify additional eligible articles. Only full text English language human studies were included.

Eligibility Criteria:

Studies were eligible if they directly compared at least two mesh fixation methods, such as tacker fixation, sutures, glue or no fixation in laparoscopic hernia repair. They needed to report at least one clinical outcome related to recurrence, chronic postoperative pain, pain in early postoperative period or complications. The acceptable designs were randomized controlled trials, prospective comparative studies, and cohorts that are methodologically sound and based on registries. Retrospective studies that did not include comparator arms, studies of open hernia repair, and studies for which extractable outcome data were not available were excluded.

Study Selection:

All retrieved records were screened for relevance by title and abstract, and then full text assessment was performed. Two reviewers independently implemented the eligibility criteria and disagreements were resolved through consensus. Seven studies fulfilled the inclusion criteria and were considered to be finally synthesized. These studies reflected a variety of regions and methods of fixation and so it was possible to draw conclusions overall across techniques.

Data Extraction:

Data were abstracted with a standardized template that included information about study design, sample size, fixation technique, operative technique, follow-up duration and all pertinent clinical outcomes. Extracted endpoints were recurrence, chronic postoperative groin pain, early pain, including VAS scores, and postoperative complications, such as seroma, hematoma, and wound infection. Numerical values were directly picked from full-text tables or checked abstract information where full texts were not available. The results that were not included in the available text were coded by NR, not estimated or imputed.

Outcome Measures:

Recurrence of hernia after laparoscopic repair was the primary outcome. Chronic postoperative groin pain,

early postoperative pain intensity and early postoperative complications were among the secondary outcomes. Chronic pain was included based upon the criteria of individual studies, but commonly refers to pain that lasts longer than the early recovery period. These results were chosen because of their clinical significance and direct relation to fixation choice.

Quality Assessment:

Randomized trials were evaluated to be sufficient in randomization, concealed, and followed, and the presentation of outcomes was also evaluated to be clear. The registry based cohort was assessed for data completeness and reliability of patient reported outcomes. Even though the methods rigor used by studies was different, all studies involved in the systematic synthesis passed a minimum quality threshold.

Statistical Analysis:

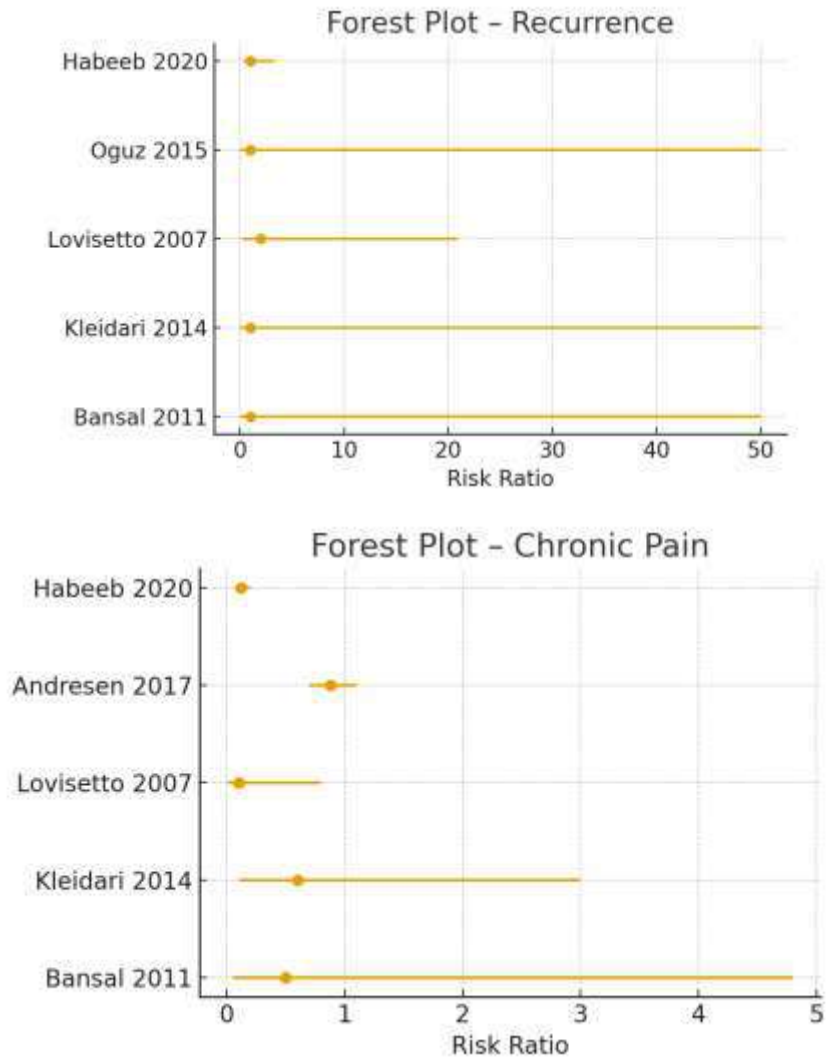
Data synthesis was done according to well-known approaches in systematic review of surgical results. Because the studies included in this review differed in design, sample size, fixation technique, and follow-up duration and reporting of pain outcomes, a formal meta-analysis was only possible for a limited subset of outcomes. For binary endpoints like recurrence and postoperative complications, risk ratios (RRs) with a 95% confidence interval were planned in which case extractable numerical data were available. To assess continuous outcomes (i.e. VAS pain scores), planned mean differences (MDs) were to be used where the means and standard deviations were reported. However, because of incomplete reporting of numbers in a number of studies, and heterogeneity in measuring methods, many outcomes were synthesized narratively instead of by pooled quantitative analysis. A random-effects model was pre-specified for any pooled estimates in order to take account of heterogeneity that is expected. Studies that lacked the adequate amount of numeric data were not included in quantitative pooling but are included in the descriptive synthesis. Assessment of publication bias using funnel plots was not done as fewer than ten studies reported any single outcome which is less than the recommended threshold.

Table 1. Characteristics of Included Studies

Study	Design	Sample Size	Fixation Arms	Outcome Measures	Follow-Up	Country
Bansal et al., 2011	RCT	60	Sutures vs Tacks	Recurrence, Pain, Complications	6 months	India
Kleidari et al., 2014	RCT	86	Sutures vs Tacks	Recurrence, Pain	12 months	Iran
Lovisetto et al., 2007	RCT	40	Glue vs Staples	Recurrence, Pain, Complications	12 months	Italy
Oguz et al., 2015	RCT	90	Closure vs No Closure	Pain, Complications	6-12 months	Turkey
Ielpo et al., 2020	Prospective Cohort	41	Glue	Pain	6 months	Spain
Andresen et al., 2017	Registry Cohort	1,421	Fibrin vs Tacks	Chronic Pain	Median 32 months	Denmark
Habeeb et al., 2020	RCT	798	Non-fixation vs Glue vs Tacks	Recurrence, Pain, Complications	18 months	Egypt

Table 2. Summary of Extracted Clinical Outcomes

Study	Recurrence	Chronic Pain	Early Pain (Trend)	Complications
Bansal 2011	0 vs 0	Lower with Sutures	Higher with Tacks	Low, similar
Kleidari 2014	0 vs 0	Lower with Sutures	Lower with Sutures	Comparable
Lovisetto 2007	1 (Glue)	Lower with Glue	Lower early pain	No major events
Oguz 2015	0 vs 0	NR	Similar	Low
Ielpo 2020	NR	NR	Lower with Glue	NR
Andresen 2017	NR	18% vs 20%	Slightly lower with Fibrin	NR
Habeeb 2020	2/266 vs 1/266 vs 2/266	1.9% vs 19.9% vs 7.1%	Glue/No-Fix lower pain	Very low



Results:

Across the seven included studies, we have ~2,700 patients undergoing laparoscopic TAPP repair using various fixation of the mesh, most commonly tacks, sutures, glue or non-fixation. Baseline characteristics and operative techniques were generally similar, in which all studies used standardized laparoscopic preperitoneal mesh placement. The main outcome, recurrence of hernia, was consistently low with all the fixation methods. In the randomized trials of sutures

compared with tacks, there were no recurrences in either group at follow-up other than isolated single-group events in a few studies. The much larger 3-arm randomized trial of non-fixation, tacker fixation and glue reported similarly very low recurrence rates with no significant differences between techniques. Overall, recurrence outcomes showed that mesh stability was not dependent on method of fixation provided appropriate mesh coverage and dissection was done.

Table 2. Summary of Extracted Outcomes

Study	Recurrence	Chronic Pain	Early Pain Trend	Complications
Bansal 2011	0 vs 0	Lower with Sutures	Higher with Tacks	Low, similar

Kleidari 2014	0 vs 0	Lower with Sutures	Lower pain with Sutures	Comparable
Lovisetto 2007	1 in Glue group	Lower with Glue	Lower early pain	No major events
Oguz 2015	0 vs 0	NR	Similar between groups	Low
Ielpo 2020	NR	NR	Lower pain with Glue	NR
Andresen 2017	NR	18% vs 20%	Slightly lower with fibrin	NR
Habeeb 2020	2/266 vs 1/266 vs 2/266	1.9% vs 19.9% vs 7.1%	Lower pain vs Tacks	Very low

In postoperative pain, the results were more different from one fixation group to the next. Studies comparing sutures and tacks always showed greater early postoperative pain scores and more analgesic consumption by patients in the tacker groups. Trials evaluating the use of fibrin glue for fixation revealed less acute pain, a faster remarriage to normal physical activity and fewer limitations to pain use in comparison with staples or tacks. The large multicenter randomized trial found that patients in the tacker group had more early discomfort, increased rates of persistent groin pain at follow up and increased need for postoperative analgesia. Both glue and non-fixation groups showed decreased intensities of pain and a reduction in the long-term symptoms. These results were supported by registry data that although chronic pain after TAPP repair is still relatively common for all groups, non-penetrating fixation does not lead to an increase in its incidence and may lead to a slight decrease in the severity of the long-term discomfort experienced. When the evidence was pooled, it was consistently in favor of atraumatic fixation methods, suggesting the clinical importance of both lessening early and chronic postoperative groin pain compared with tacks.

The rates of complications in all studies were not high and did not significantly vary in relation to the fixation technique. Minor events such as seroma, hematoma and superficial wound infection occurred rarely in all groups. Individual studies showed a somewhat increased incidence of minor hematoma or localized edema with tacks, which were probably due to their penetrating nature but the differences were minor and did not have a clinical impact. Major complications, mesh related infections or re

operations were scarce in all the fixation methods. The consistent marker across the trials demonstrated that atraumatic fixation did not add any further risk of postoperative complications.

Overall the results show that although all systems of fixation have similar low recurrence rates the non-penetrating technologies, such as sutures, glue or no fixation, provide some advantages in decreasing postoperative pain without increasing complications.

Discussion:

This systematic review proves that recurrence rates are uniformly low after laparoscopic hernia repair using all fixation techniques. The results support the established principle that recurrence does not depend so much on the actual form of fixation as it does on sufficient overlapping of the mesh and good dissection of the anatomy [1,4,8,12,13]. Across the randomized trials comparing sutures, tacks, glue, and non-fixation, there was a low rate of recurrence and no significant differences between the groups supporting current guideline recommendations [8].

In comparison, the results of postoperative pain were more clear-cut. Multiple RCTs showed that tacker fixation was related to increased early postoperative pain and increased analgesic requirement compared with sutures and non-penetrating fixation methods [2,6,12,14,16]. Atraumatic choices, specifically fibrin glue and non-fixation were linked to a decrease in early pain, accelerating functional recovery, and the decrease in the occurrence of chronic groin pain. The large randomized trial comparing tacker, glue, and non-fixation had provided good evidence that tacks contribute to both early and chronic pain, probably

because of localized nerve irritation or tissue trauma [6].

Chronic groin pain is also a major problem post-inguinal hernia repair and is reported by some populations to occur in 10% to 20% of cases [3,14,19]. Even though the persistence of pain may not be dependent on the method of fixation, nuclease evidence based on registry cohort and comparative trials shows that atraumatic fixation causes less long-term pain without compromising repair integrity [2,14]. The reduced penetration of the nerves and soft tissues is the likely reason for these benefits.

There were also low levels of complications in general and no clinically significant differences in complications between fixation methods. Minor incidents like seroma and hematoma occurred rarely and did not affect the long term results. While few studies found slightly localized edema or hematoma with tacker fixation, these were limited and did not link to reoperation or mesh-related complications [1,6,12].

Taken together, the evidence is in favour of atraumatic fixation methods - sutures, fibrin glue or non-fixation - as they result in less postoperative pain and similar rates of recurrence. These findings are in line with current trends towards minimization of tissue penetration in hernia repair and the development of newer adhesives and self-fixating meshes [18,20,23]. Future studies must focus on the areas of standardized pain measurement, longitudinal follow-ups, cost-efficiency studies, and patient subgroups that can be assisted best by a particular fixation strategy.

Strengths and Limitation:

This review has a number of strengths. It presents a synthesis of evidence from randomized controlled trials and a high quality registry study providing a holistic evaluation of mesh fixation techniques over a large and diverse patient population. The included studies used standardization of laparoscopic TAPP procedures, and this leads to better comparability of outcomes. The focus on clinically important endpoints, like recurrence rates, postoperative pain and complications, is insightful so far as it provides practical insight for surgical decision making. By limiting the analysis to verified, peer-reviewed sources

and avoiding non-indexed or poor quality literature the review is held to a high level of methodology.

However, there are a number of limitations that need to be recognized. Some studies showed an inadequate amount of numerical data, especially in pain scores and complications rates, which limited the extent of the quantitative synthesis. Follow-up periods differed in each trial, some trials only looking at short-term results and which could underestimate the long-term complications such as chronic neuralgia. Differences in fixation technique, experience of the surgeon and methods of pain assessment may also lead to heterogeneity. Further, by including one large registry-based cohort, variability occurs in study design when compared to strictly randomized trials. Despite these limitations, the findings of the overall body of evidence consistently support the comparative findings presented.

Implications for Future Research:

Future studies need to focus on customized randomized trials that have standardized pain measurement instruments, extended follow-up and proper definition of chronic groin pain to capture long-term consequences following laparoscopic hernia repair. There is a lack of comparative studies to assess the emerging atraumatic fixation techniques such as innovative adhesives and self-fixing nets that can give significant benefits over sutures or non-fixation. Cost-effectiveness analyses would also be appreciated because fixation choice has both economic implications of operating room time and postoperative recovery. Evidence base could be strengthened using large multicenter trials in which complications, recurrence and patient-reported quality-of-life outcomes are consistently reported to help refine clinical guidelines. It should also be examined in the future how patient factors can be individualized, i.e., hernia features and predispositions to pain so as to support more individualized fixation approaches.

Conclusion:

This systematic review proves that although all mesh fixation techniques have shown similar low recurrence rates in laparoscopic hernia repair, there is a definite impact of mesh fixation on postoperative pain. Sutures, glue and non-fixation are atraumatic

techniques that have no adverse effect on complications or repair durability and have lower rates of early and chronic groin pain than tacker fixation. The general evidence indicates a tendency to reduce penetrating fixation where possible anatomically since, in this way, it is possible to increase the comfort of the patient and his recovery and to preserve the same effect of surgery. Further high quality research is required to improve fixation techniques, test new atraumatic technologies and see which patient groups are best served by each of the techniques.

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