

# Assessment of feasibility and safety of cyanoacrylate glue versus absorbable tacks for inguinal hernia mesh fixation. A prospective comparative study

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## Abstract

**Introduction:** Mesh fixation is one of the most important steps in laparoscopic inguinal hernia repair. Tacks are often used and provide reliable fixation but they increase the risk of bleeding and chronic pain. To decrease chronic pain, absorbable tacks have been more recently developed. Another method is fixation via glue, which is the most minimally invasive approach, but it may theoretically lead to higher rates of fixation failure.

**Aim:** To analyse the intraoperative mesh fixation success rate and postoperative outcomes between cyanoacrylate and absorbable tacks in laparoscopic transabdominal preperitoneal (TAPP) inguinal hernia repair.

**Material and methods:** Adult patients who underwent TAPP hernia repair were included prospectively. Patients were split into two groups: the study group (LB) in which the mesh was fixed with cyanoacrylate glue and the control group (AT) in which absorbable tacks were used. Main outcomes were fixation success rate, early postoperative pain, chronic pain, patient reported outcomes and recurrence rate.

**Results:** The mesh fixation success rate when using LB was 96.70% ( $n = 88$ ), while in the AT group, the mesh fixation success rate was 100% ( $n = 120$ ). Patients in the AT group had significantly higher pain scores than patient in the LB group ( $p < 0.001$ , 95% CI). There was no significant difference in chronic pain, patient reported outcomes or recurrences between the two groups.

**Conclusions:** Cyanoacrylate glue is a safe option for mesh fixation in transabdominal preperitoneal laparoscopic inguinal hernia repair with improved early postoperative pain and similar chronic pain, patient reported outcomes and recurrence when compared to absorbable tack fixation.

**Key words:** transabdominal preperitoneal, laparoscopic surgery, hernia, tack fixation, glue fixation, hernia surgery.

## Introduction

Inguinal hernia is the most prevalent type of abdominal wall hernia, and its repair is a highly common procedure, ranging from 10 to 28 operations per 100 000 inhabitants [1, 2]. Its ubiquity has led to a quick and constant improvement in surgical technique to improve postoperative outcomes. Mesh fix-

ation of hernias has become the gold-standard treatment after showing significantly lower recurrence rates and overall better outcomes than non-mesh repairs [3, 4]. While both laparoscopic and open repairs have proven reliable procedures, laparoscopic approaches are becoming more popular due to less postoperative pain and earlier recovery compared

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to open repair as proven by various studies [5–7]. In open procedures the mesh can be easily fixed via sutures, but in laparoscopy, although feasible, suturing is more difficult and such alternative methods for mesh fixation have been described. Staples, tacks or glue are used to fix the mesh with ease, thus reducing operative time. However, tacking techniques are associated with important complications such as chronic pain [8, 9], hematoma formation [10], severe bleeding (inferior epigastric pedicle injury) [11] or bowel fistula [11]. To overcome the risk of chronic complications due to tack entrapment absorbable tacks have been designed which fix the mesh only until it is integrated by the host tissue, after which fixation should no longer be required [12].

A recent systematic review and meta-analysis, analysing three randomized controlled trials and two observational studies, showed similar outcomes between absorbable and permanent tacks [13]. Thus, the more expensive absorbable tacks are not yet justified. Another recent alternative for mesh fixation is the use of cyanoacrylate glue, which is already used with success on skin grafts [14] and vascular anastomosis [15]. Glue is a non-penetrating technique for mesh fixation and risks of nerve, vessel or muscle injury should be eliminated, reducing postoperative pain and improving patient satisfaction. However, some would argue that it is not

as capable as tacks in anchoring the mesh in the preperitoneal plane.

## Aim

Herein we aimed to analyse the intraoperative mesh fixation success rate and postoperative outcomes between cyanoacrylate glue versus absorbable tacks in laparoscopic transabdominal preperitoneal inguinal hernia mesh repairs.

## Material and methods

### Design and setting

This is a prospective comparative study conducted at Naas General Hospital, Ireland on patients who underwent laparoscopic transabdominal preperitoneal (TAPP) inguinal hernia repair between 2018 to 2020. Prospective survey methodology was used to compare the feasibility of mesh fixation and postoperative outcomes in two studied groups: cyanoacrylate glue (LiquiBand FIX8, Advanced Medical Solutions, U.K., LB) and absorbable tacks (5 mm, violet absorbable tacks, AbsorbaTack, Covidien, Ireland, AT).

Patients were selected in a non-randomized way to one of the two treatment arms, the study group (LB) or the control group (AT), at a 1 : 1 ratio. The CONSORT flow was followed throughout the study (Figure 1). A single repair technique (TAPP) was per-

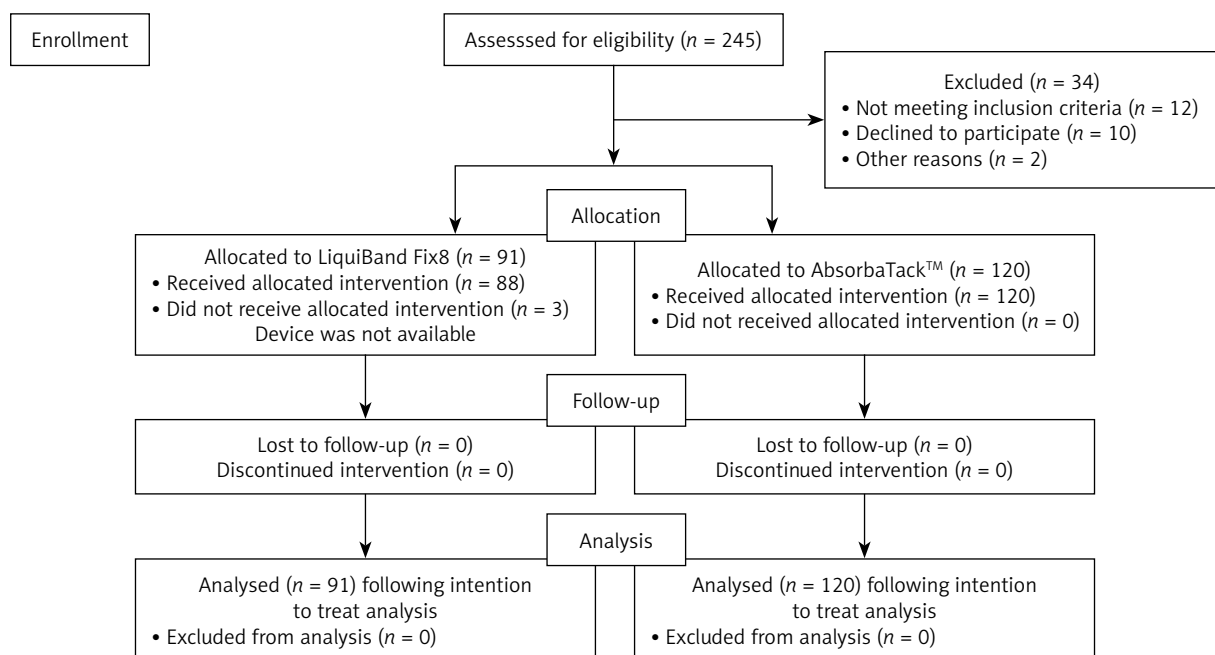


Figure 1. CONSORT flow diagram

formed for all patients to maintain homogeneity and keep appropriate distribution between the study and control devices. The decision to use LB or AT was made based on preoperative patient preference (the patient was informed about the method, advantages and disadvantages of each device) or intraoperative surgeon preference. Once the preperitoneal flap was dissected, if there was significant oozing, then AT were used as LB does not efficiently adhere to a wet surface and the risk of clogging the tip is increased. After reviewing the available classifications for groin hernias, the authors selected the European Hernia Society (EHS) [16] as a method for intraoperative classification and description.

**Inclusion criteria**

We included all adult patients diagnosed with unilateral/bilateral groin hernia who were candidates for TAPP repair and willing to be part of the study. We analysed both elective and emergency repairs. We included only patients with an American Society of Anaesthesiologists (ASA) grade less than 4.

**Exclusion criteria**

Patients with recurrent groin hernia or who had previous preperitoneal dissection or pelvic radiotherapy were excluded from the study. Patients with ASA 4 or 5 were excluded. Paediatric cases were also excluded.

**Data collection and follow-up**

We used a standardized operative form to describe the type of hernia and type of procedure using the European Hernia Society (EHS) classification [16]. The main operator or assistant filled in the forms on the day of admission and at every outpatient visit. Face to face outpatient visits were scheduled at 6 weeks, 6 months and 1 year postoperatively. At 2 years postoperatively, satisfaction scores and recurrence rates were evaluated virtually (i.e., phone

call). The exact follow-up date varied within 1–2 weeks depending on clinic slot availability, bank holidays, etc. Patients had direct access to the unit’s secretary and were instructed to call if they had concerns and could book in for urgent outpatient visits if required. These forms were transferred to an electronic database by junior surgeons and included: patient demographics, medical history (surgical, cardiovascular, respiratory and metabolic risk factors or comorbidities), ASA grade, hernia type, procedure type, early postoperative complications (e.g., hematoma, seroma, surgical site infection) and patient reported outcomes. The patients’ name and medical record number (MRN) were coded during data collection and analysis. The immediate and early postoperative pain was assessed by reviewing patients before discharge and at 6 weeks postoperatively. The Visual Rating Scale (VRS) was used to assess level of pain. Patients were asked to scale their pain from one (least) to ten (unbearable pain) and then the pain was classified as being mild (pain score 1–3), moderate (pain score 4–5) or severe (6–10). Postoperative pain was defined as acute if it persisted up to 6 weeks postoperatively or chronic if it persisted after this. Only acute pain was analysed based on severity, while chronic pain was evaluated only through its presence. Surgical complications were defined as early if they occurred in the first 6 weeks postoperatively and late after this date. Patient satisfaction and quality of life were assessed via the Patient Reported Outcome Measures (PROMs) questionnaire (Table I) and by using the Likert scale to provide quantitative data, which were further analysed via  $\chi^2$  and Mann-Whitney tests (Table II).

**Surgical technique**

All procedures were day cases, performed under general anaesthesia, by using a laparoscopic TAPP as previously reported [17]. The mesh fixation method was either using LB or AT based on the patient preference and intraoperative, pre-fixation, surgeon

**Table I.** Patient reported outcomes after hernia repair

Variable		PROME score 10–12 Acceptable	PROME score 13–15 Good		P-value
Fixation	AT	56	64	120	0.146
	LB	35	56	91	
Total		91	120	211	

LB – LiquiBand group, AT – absorbable tacks group.

**Table II.** Analysis of mesh fixation success rate and number of devices used

Variable	Number of devices			Mesh fixation success		
	One device	Two devices	Three devices	Successful fixation	Fixation failure	Total
AT	118	2	0	120	0	120
LB	85	5	1	88	3	91
Total	203	7	1	208	3	
Pearson $\chi^2$		0.155			0.045	

LB – LiquiBand group, AT – absorbable tacks group.

preference. Once allocated to a group, fixation was declared successful if done via the assigned method, regardless of the number of devices used. If after allocation to one of the two fixation methods the surgeon would change the method (e.g., initially allocated to glue, but then the surgeon would opt for sutures or tacks), then that fixation would be assigned to mesh fixation failure. If the surgeon required another similar device, because the first one had technical issues, but did not change the method of fixation, then that case would be assigned to the device failure rate but would not be regarded as a mesh fixation failure.

After preperitoneal dissection and reduction of the hernia sac, it is our routine practice to dry the preperitoneal space with a dental gauze swab. This facilitates optimal application of the glue by preventing tip clogging of the device through backflow of blood or fluid.

A 10 × 15 cm DynaMesh-ENDOLAP 3D was used in all cases. We used medial to lateral fixation of the mesh at five anchoring points: starting medially (i.e., 9 o'clock for a right sided repair) at the pubic tubercle, then at 12 o'clock and 6 o'clock (superior and inferior border of the mesh) and then lateral to the inferior epigastric vessels, at two points (i.e., for a right sided hernia at 2 and 4 o'clock). From our experience, the glue can be applied on the triangle of doom and triangle of pain without significant intra-operative and postoperative adverse events. When applying the glue, it is important to stabilise the mesh against the abdominal wall using a grasper (e.g., Yohan grasper) in the non-dominant hand. We closed the peritoneum using V-Loc sutures instead of glue or tacks. This is more cost-effective and avoids using another LB device for a single hernia repair. Also, the risk of tack related complications is reduced [18]. For the control group (AT), the mesh was fixed via three anchoring points: one medially at the pubic tubercle

and another two, one medial to the epigastric vessels and one lateral to it. We always make sure to have a clear view of the musculoaponeurotic layer when applying the tacks. The rest of the procedure followed similar steps to the study group.

## Results

### Fixation success rate

A total of 211 patients were included in the study, divided into two groups: the study group, in which LB was used to fix the mesh ( $n = 91$ ) and the control group, in which AT was used ( $n = 120$ ). The vast majority of hernias were primary (96.7%,  $n = 88$ , in LB groups versus 95%,  $n = 114$ , in the AT group). Both groups were comparable in terms of type and size of the hernia (Table III). The median follow-up period was 28 months (range: 15–42) for LB and 22 months (range: 6–32) for the AT.

The mesh fixation success rate when using LB was 96.70% ( $n = 88$ ). The device failure rate in LB was 6.6% ( $n = 6$ ). In all 6 cases, the LB device had to be changed due to clogging. A single LB device was required for complete mesh fixation in 93.40% ( $n = 85$ ) of cases. In the AT group, the mesh fixation success rate was 100% ( $n = 120$ ). The device failure rate was 1.66% ( $n = 2$ ), in which an alternative AT device was required to complete fixation (Table II).

### Acute pain

Acute pain was classified into mild, moderate and severe. 83.51% ( $n = 76$ ) of patients in the LB group experienced mild pain. No patients in the LB group reported pain scores higher than 5, based on the VRS scale. In the AT group, 96.6% ( $n = 116$ ) of patients reported mild pain and 3.3% ( $n = 4$ ) had a pain score higher than 5. When analysed via the chi square test, patients in the AT group had significant-

**Table III.** Preoperative classification of hernias by occurrence, type and size

Fixation types				LB	AT	P-value
Total number				91 (100%)	120 (100%)	
Occurrence		Primary		88 (96.7%)	114 (95%)	0.403
		Recurrent		3 (3.3%)	6 (5%)	
Type	Femoral	F1	2	2 (2.2%)	2 (1.7%)	0.724
		F2	2			
		F3	0			
	Lateral	L1	102	80 (87.9%)	102 (85%)	
		L2	49			
		L3	31			
	Medial	M1	2	9 (9.9%)	16 (13%)	
		M2	8			
		M3	15			
Size (overall)		< 1.5 cm		37 (40.7%)	44 (36.7%)	0.304
		2–3 cm		35 (38.5%)	58 (48.3%)	
		> 3 cm		19 (20.9%)	18 (15%)	

EHS – European Hernia Society, LB – LiquiBand group, AT – absorbable tacks group, F1 – femoral hernia less than 1.5 cm, F2 – femoral hernia between 2–3 cm, F3 – femoral hernia more than 3 cm, L1 – lateral hernia less than 1.5 cm, L2 – lateral hernia between 2–3 cm, L3 – lateral hernia more than 3 cm, M1 – medial hernia less than 1.5 cm, M2 – medial hernia between 2–3 cm, M3 – medial hernia more than 3 cm.

ly higher pain scores than patients in the LB group ( $p < 0.001$ , 95% CI) (Table IV).

chronic pain in the LB group versus 3.3% ( $n = 4$ ) in the AT group (Table V).

**Chronic pain**

There was no statistically significant difference in chronic pain between the two groups ( $p = 0.479$ , 95% CI). 2.19% ( $n = 2$ ) of patients experienced

**Patient reported outcomes**

The patients were evaluated using the PROMs questionnaire at their clinic follow-up, up to 1 year after the surgery (the minimum follow-up period

**Table IV.** Acute pain analysis

Variable		Mild pain (Pain score from 1–3)	Moderate pain (Pain score 4 and 5/10)	Severe pain (Pain score from 6–10)	Total	P-value
Fixation	AT	58	58	4	120	< 0.001
	LB	83	8	0	91	
Total		141	66	4	211	

LB – LiquiBand group, AT – absorbable tacks group.

**Table V.** Chronic pain analysis

Variable		Chronic pain		Total	P-value
		No chronic pain	Chronic pain		
Fixation	AT	116	4	120	0.479
	LB	89	2	91	
Total		205	6	211	

LB – LiquiBand group, AT – absorbable tacks group.

**Table VI.** Hernia recurrence rates

Variable	Recurrence		Total	P-value
	No recurrence	Recurrence		
Fixation	AT	120	0	0.431
	LB	90	1	
Total		210	1	

LB – LiquiBand group, AT – absorbable tacks group.

was 6 months). The 2-year follow-up rate was 70% ( $n = 148$ ) in our cohort (median: 29 months, range: 14–40). There was no significant difference in patient reported outcomes between the two groups (Table I).

### Recurrence rate and complications

There was 1 case of hernia recurrence in the LB group (recurrence rate = 0.4%) and no recurrences in the AT group (recurrence rate = 0%). A single case of recurrence was diagnosed in the LB group, which was detected at 5 months postoperatively when the patient requested a visit due to concerns of recurrence. The initial hernia was a medial one (direct) with a size of 3.2 cm. This case was reoperated on via a TAPP approach; the old mesh was left in situ, laterally migrated, and a new, similar mesh was fixed onto the myopectineal orifice via absorbable tacks placed at the pubic tubercle and the superior quadrants. Other procedure related complications were recorded by the surgical team during follow-up and, for both groups, included seroma 2.4% ( $n = 6$ ), port site bleeding 0.3% ( $n = 2$ ), and port site hernia 0.3% ( $n = 2$ ) (Table VI).

### Discussion

Our results show that mesh fixation with cyanoacrylate glue is associated with less pain in the early postoperative period and with similar chronic pain, patient reported outcomes and recurrence rates compared to mesh fixation with absorbable tacks. These results corroborate earlier studies [19, 20] which showed that glue is a quick, non-traumatic method to safely fix the mesh, reducing postoperative pain, without increasing failure or recurrence rates. N-butyl-2-cyanoacrylate is a tissue adhesive widely used for skin incisions. Its initial liquid form makes it easy to apply and the subsequent quick polymerization into a solid, waterproof adhesive enables secure tissue fixation.

When using glue, it is highly important to ensure the operative field is dry, otherwise in our experience the glue will not adhere, or the tip of the device will clog in contact with fluids. This was the reason for the three failures in the LB group. Thus, one should dry the operative field before using the LB device or use another fixation method from the start. In our study there were six failure cases in the AT group. In these cases, the tacks did not reach the fascia due to thickened preperitoneal fat. To tackle this, one must ensure that there is a clear view of the musculoaponeurotic layer when firing tacks or using glue, as we did in these 6 cases with success. While adopting TAPP repair by an inexperienced surgeon demands at least 50 cases to become proficient [21], using glue for fixation does not require a learning curve apart from a simple preoperative technical overview as the repair technique remains roughly similar to the original TAPP. All procedures in this study were performed by surgeons experienced in TAPP repairs.

Application of n-butyl-2-cyanoacrylate is less traumatic than sutures or tacks and, in our experience, can be safely applied on both the triangle of doom and triangle of pain when performing TAPP hernia repairs. Indeed, sutures and tacks provide better mechanical support in the first 14 days, but in the medium and long-term follow-up, meshes fixed with tissue adhesives show similar integration and durability as shown in a previous pre-clinical study [22]. What matters probably more than the method of fixation is the size of mesh used. As previously proven, it is imperative to use a minimal size of 10.4 × 13.2 cm in order to cover the entire myopectineal orifice in hernias less than 3 cm and 13 × 15.6 cm in hernias more than 3 cm [23]. Herein we preferred a 10 × 15 cm mesh, which intraoperatively seemed appropriate for all hernias in this study. We found a single recurrence after 2 years of follow-up in a 3.2 cm direct hernia. It is difficult to predict wheth-

er this was a case of fixation failure causing lateral migration of the mesh or inappropriate mesh size.

Pain is probably the most well-known complaint surgeons face postoperatively, and given that nerve entrapment is an important cause of it a plethora of studies have proposed less and less invasive fixation methods. Even more, a growing body of evidence has shown that applying the mesh without any fixation is feasible, decreasing postoperative pain without increasing recurrence rates [24, 25]. Despite this, to avoid migration, the vast majority of surgeons are more comfortable when fixing the mesh. Glue is a proven balanced option offering the best of both worlds: reliable fixation without the use of foreign bodies that could cause entrapment and subsequent postoperative pain [26].

A recent randomized controlled trial published by Mohammadi Tofigh *et al.* [27] comparing sutures versus N-hexyl cyanoacrylate in 58 patients with inguinal hernias who underwent Lichtenstein repair showed reduced operative time and less postoperative pain in the glue group. This is in line with the similar results of an earlier systematic review and meta-analysis on Lichtenstein inguinal hernia repairs using either glue or sutures to fix the mesh [28]. For open procedures, there are enough supporting data favouring n-butyl-2-cyanoacrylate glue for mesh fixation compared to sutures; however, for laparoscopic procedures the evidence is not yet strong. Moreover, studies comparing n-butyl-2-cyanoacrylate to tacks in TAPP procedures are scarce. To our knowledge two studies [29, 30] have compared n-butyl-2-cyanoacrylate to tacks in laparoscopic hernia repair, but in both studies repair was done in a total extra-peritoneal fashion (TEP). Both studies showed that n-butyl-2-cyanoacrylate is similar to tacks in terms of mesh fixation, chronic pain and risk of recurrence. Yu *et al.* [30] noted less acute pain in the n-butyl-2-cyanoacrylate group and similar chronic pain compared to tacks. In our study all procedures were TAPP, and the results are consistent with the aforementioned studies. More commonly fibrin glue was used, and a meta-analysis published in 2013 by Sajid *et al.* [31] showed that fibrin glue fixation is associated with less pain and similar recurrences compared to tacks. Another meta-analysis published by Antoniou *et al.* [32] reached a similar conclusion.

Traditionally, studies have compared different repair techniques in the light of surgical complications such as wound infection, chronic pain and re-

currence, but it is now accepted and recommended that functional outcomes, patient satisfaction and quality of life are considered when adopting new approaches [33, 34]. Herein we used the previously reported PROMs [17], which are split into five main questions with regards to pain, mobility, self-care at home, daily activities and satisfaction. Each question is scored with 1, 2 or 3 points based on the answer given, summing up to a maximum grade of 15. Indeed, there is still significant variability in how authors quantify patient reported outcomes. The lack of standardization needs to be addressed. This has been highlighted by Wilcox *et al.* [35] and it is something we need to change also in future publications.

There are a number of limitations of the study. Randomization of patients was not possible due to logistical reasons in our unit; thus the decision to use LB or AT was based on patient preference or at the surgeons' discretion. Whenever there was a damp dissection plane, we preferred to use AT. Also, once the medial and lateral inguinal fossae were dissected, if the fascial plane was not clearly visible (e.g., in patients with increased preperitoneal fat pad) we preferred to use LB, rather than risking firing tacks into loose preperitoneal fat. We chose not to analyse the operative time as it would not affect the rate of postoperative pain and recurrence. Reduction of operative time when using tissue adhesives is widely proven already. This study aimed to analyse the feasibility and safeness in using LB to fix the mesh in the preperitoneal space with special regards to the incidence of postoperative pain and recurrence compared to the control group in which AT was used.

## Conclusions

Cyanoacrylate glue is a safe technique for mesh fixation in transabdominal preperitoneal laparoscopic inguinal hernia repair with improved early postoperative pain and similar chronic pain, patient reported outcomes and recurrence when compared to absorbable tacks.

## Conflict of interest

The authors declare no conflict of interest.

## References

1. Jenkins JT, O'Dwyer PJ. Inguinal hernias. *BMJ* 2008; 336: 269-72.
2. Burcharth J, Pedersen M, Bisgaard T, et al. Nationwide prevalence of groin hernia repair. *PLoS One* 2013; 8: e54367.

- Lockhart K, Dunn D, Teo S, et al. Mesh versus non-mesh for inguinal and femoral hernia repair. *Cochrane Database Syst Rev* 2018; 9: CD011517.
- Grant AM; EU Hernia Trialists Collaboration. Open mesh versus non-mesh repair of groin hernia: meta-analysis of randomised trials based on individual patient data. *Hernia* 2002; 6: 130-6.
- Bullen NL, Massey LH, Antoniou SA, et al. Open versus laparoscopic mesh repair of primary unilateral uncomplicated inguinal hernia: a systematic review with meta-analysis and trial sequential analysis. *Hernia* 2019; 23: 461-72.
- Neumayer L, Giobbie-Hurder A, Jonasson Q, et al.; Veterans Affairs Cooperative Studies Program 456 Investigators. Open mesh versus laparoscopic mesh repair of inguinal hernia. *N Engl J Med* 2004; 350: 1819-27.
- Elmessiry MM, Gebaly AA. Laparoscopic versus open mesh repair of bilateral primary inguinal hernia: a three-armed randomized controlled trial. *Ann Med Surg* 2020; 59: 145-50.
- Shah NS, Fullwood C, Siriwardena AK, Sheen AJ. Mesh fixation at laparoscopic inguinal hernia repair: a meta-analysis comparing tissue glue and tack fixation. *World J Surg* 2014; 38: 2558-70.
- Andresen K, Rosenberg J. Management of chronic pain after hernia repair. *J Pain Res* 2018; 11: 675-81.
- Chandra P, Phalgune D, Shah S. Comparison of the clinical outcome and complications in laparoscopic hernia repair of inguinal hernia with mesh fixation using fibrin glue vs Tacker. *Indian J Surg* 2016; 78: 464-70.
- Wilson P, Hickey L. Laparoscopic transabdominal preperitoneal (TAPP) groin hernia repair using n-butyl-2-cyanoacrylate (Liquiband®Fix8™) for mesh fixation and peritoneal closure: learning experience during introduction into clinical practice. *Hernia* 2019; 23: 601-13.
- Johnston S, Lau C, Dargusch MS, Atrens A. Absorbable Mg surgical tack: proof of concept and in situ fixation strength. *J Mech Behav Biomed Mater* 2019; 97: 321-9.
- Khan RMA, Bughio M, Ali B, et al. Absorbable versus non-absorbable tacks for mesh fixation in laparoscopic ventral hernia repair: a systematic review and meta-analysis. *Int J Surg* 2018; 53: 184-92.
- Grimaldi L, Cuomo R, Brandi C, et al. Octyl-2-cyanoacrylate adhesive for skin closure: eight years experience. *In Vivo* 2015; 29: 145-8.
- Bot GM, Bot KG, Ogunranti JO, et al. The use of cyanoacrylate in surgical anastomosis: an alternative to microsurgery. *J Surg Tech Case Rep* 2010; 2: 44-8.
- Miserez M, Alexandre JH, Campanelli G, et al. The European hernia society groin hernia classification: simple and easy to remember. *Hernia* 2007; 11: 113-6.
- Haroon M, Al-Sahaf O, Eguare E, et al. Postoperative outcomes and patient's satisfaction after hybrid TIPP with UHS and TEP repair for inguinal hernias: a single-centre retrospective comparative study. *Chirurgia* 2019; 114: 57-66.
- Mittermair R, Jenic G, Kolenik R, Sorre C. TAPP surgery with mesh fixation and peritoneal closure using n-butyl-2-cyanoacrylate (LiquiBand®FIX8™) – initial experience. *Eur Surg* 2016; 48: 110-4.
- Wilson P, Hickey L. Laparoscopic transabdominal preperitoneal (TAPP) groin hernia repair using n-butyl-2-cyanoacrylate (Liquiband®Fix8™) for mesh fixation and peritoneal closure: learning experience during introduction into clinical practice. *Hernia* 2019; 23: 601-13.
- Shah NS, Fullwood C, Siriwardena AK, Sheen AJ. Mesh fixation at laparoscopic inguinal hernia repair: a meta-analysis comparing tissue glue and tack fixation. *World J Surg* 2014; 38: 2558-70.
- Goksoy B, Azamat IF, Yilmaz G, et al. The learning curve of laparoscopic inguinal hernia repair: a comparison of three inexperienced surgeons. *Videosurgery Miniinv* 2021; 16: 336-46.
- Pascual G, Mesa-Ciller C, Rodríguez M, et al. Pre-clinical assay of the tissue integration and mechanical adhesion of several types of cyanoacrylate adhesives in the fixation of lightweight polypropylene meshes for abdominal hernia repair. *PLoS One* 2018; 13: e0206515.
- Hiratsuka T, Shigemitsu Y, Etoh T, et al. Appropriate mesh size in the totally extraperitoneal repair of groin hernias based on the intraoperative measurement of the myopectineal orifice. *Surg Endosc* 2021; 35: 2126-33.
- Sahebally SM, Horan J, Rogers AC, Winter D. Fixation versus no fixation in laparoscopic totally extraperitoneal repair of primary inguinal hernia—a systematic review and meta-analysis of randomized controlled trials. *Langenbecks Arch Surg* 2020; 405: 435-43.
- Mitura K, Śmietański M, Koziel S, et al. Factors influencing inguinal hernia symptoms and preoperative evaluation of symptoms by patients: results of a prospective study including 1647 patients. *Hernia* 2018; 22: 585-91.
- Mitura K, Garnysz K, Wyrzykowska D, Michałek I. The change in groin pain perception after transabdominal preperitoneal inguinal hernia repair with glue fixation: a prospective trial of a single surgeon's experience. *Surg Endosc* 2018; 32: 4284-9.
- Mohammadi Tofigh A, Karimian Ghadim M, Bohlooli M. Comparing suture with N-hexyl cyanoacrylate glue for mesh fixation in inguinal hernia repair, a randomised clinical trial. *Am J Surg* 2021; 222: 203-7.
- Lin H, Zhuang Z, Ma T, et al. A meta-analysis of randomized control trials assessing mesh fixation with glue versus suture in Lichtenstein inguinal hernia repair. *Medicine* 2018; 97: e0227.
- Issa M, Tacey M, Geraghty J, et al. Cyanoacrylate glue versus absorbable tacks in mesh fixation for laparoscopic extraperitoneal inguinal hernia repair: a randomized controlled trial. *Surg Laparosc Endosc Percutan Tech* 2021; 31: 291-7.
- Yu CC, Chen YT, Huang CS, et al. A comprehensive study comparing tack and glue mesh fixation in laparoscopic total extraperitoneal repair for adult groin hernias. *Surg Endosc* 2020; 34: 4486-93.
- Sajid MS, Ladwa N, Kalra L, et al. A meta-analysis examining the use of tack mesh fixation versus glue mesh fixation in laparoscopic inguinal hernia repair. *Am J Surg* 2013; 206: 103-11.
- Antoniou SA, Köhler G, Antoniou GA, et al. Meta-analysis of randomized trials comparing nonpenetrating vs mechanical mesh fixation in laparoscopic inguinal hernia repair. *Am J Surg* 2016; 211: 239-49.
- Gram-Hanssen A, Tolstrup A, Zetner D, Rosenberg J. Patient-reported outcome measures for patients undergoing inguinal hernia repair. *Front Surg* 2020; 7: 17.



34. Sandø A, Rosen MJ, Heniford BT, Bisgaard T. Long-term patient-reported outcomes and quality of the evidence in ventral hernia mesh repair: a systematic review. *Hernia* 2020; 24: 695-705.
35. Wilcox AR, Trooboff SW, Wong SL. Evaluating patient-reported outcomes in inguinal hernia clinical trials. *J Surg Res* 2019; 244: 430-5.

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