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# Conventional Sutures versus Cyanoacrylate Glue in Mesh Fixation in Open Inguinal Hernioplasty

**Ashraf Ali Abdel Aziz Ali[1], Ahmed E. Sakr[2], Alaa Abdelrhman Ali El Sead Ghiat[1], Ahmed Abd Elfattah Hussein Habib[1], Ahmed Mohamed Naguib Mohamed[3], Ahmed Abdelhamid Kilany Mahmoud[3], Eslam Elshafey[4]*, Mohamed Aly Elhorbity[2]**

Departments of [1] General Surgery, [4] Clinical Pathology, Al-Ahrar Teaching Hospital, Department of [2] General Surgery, Benha Teaching Hospital, Department of [3] General Surgery, El Sahel Teaching Hospital General Organization for Teaching Hospitals and Institutes (GOTHI), Egypt

***Corresponding author:** Eslam Elshafey, **Email:** eslamelshafeyelsaid245@gmail.com, **Mobile:** 01281494169

## ABSTRACT

**Background:** Inguinal hernia repair is one of the most commonly performed surgical procedures worldwide. Conventional mesh fixation with sutures, while effective, is associated with tissue trauma, nerve entrapment, and postoperative pain. Cyanoacrylate glue has been proposed as a less invasive alternative that may improve outcomes.

**Aim:** This study aimed to compare the safety and efficacy of conventional sutures versus cyanoacrylate glue in mesh fixation during open inguinal hernioplasty. **Patients and Methods:** A prospective randomized controlled clinical trial was conducted at General Surgery Department, Al-Ahrar Teaching Hospital on eighty adult patients with primary unilateral inguinal hernia who were divided into: Group A underwent mesh fixation with non-absorbable polypropylene sutures, and Group B underwent fixation with medical-grade cyanoacrylate glue. Primary outcomes included operative time and postoperative pain while secondary outcomes included complications, return to daily activities, and recurrence.

**Results:** The glue group demonstrated a significantly shorter operative time compared to the sutures group. Postoperative pain scores were significantly lower in the glue group at all time points up to six months. Patients in the glue group resumed normal activities earlier than those in the sutures group. Complication rates were low and comparable between groups.

**Conclusion:** Cyanoacrylate glue fixation is a safe and effective alternative to sutures in open inguinal hernia repair. It offers shorter operative time, reduced postoperative pain, and faster recovery without compromising recurrence rates or safety, making it a valuable option in routine surgical practice.

**Keywords:** Inguinal hernia, Mesh fixation, Cyanoacrylate glue, Sutures, Postoperative pain

## INTRODUCTION

Inguinal hernioplasty is one of the most common surgical procedures, and hence improvements in clinical outcome are important. About 3.6% of the male population in the USA and France are subjected to inguinal hernia repair, and it is the second most common operation [(1)]. Lichtenstein hernioplasty, first recorded in 1989, is accepted widely for inguinal hernioplasty due to its efficacy, safety, and low rates of recurrence. Despite the success of such a technique in inguinal hernia repair, postoperative long-standing groin pain occurrence has posed a great challenge to surgeons. The recorded incidence of chronic groin pain (CGP) ranged from 0.7 to 62.9%. The cause of CGP can be either neuropathic or non-neuropathic in origin [(2,3)].

The best surgical method for inguinal hernia repair is still up for debate. To achieve tension-free healing, most procedures involve reinforcing of the inguinal floor with a synthetic or organic material [(4)]. Recently, the techniques of an atraumatic mesh fixation by using fibrin or butyl-2-cyanoacrylate glues have increased in the general surgery field. Glue mesh fixation may decrease the whole operating time and reduce the frequency of postoperative pain when compared with mesh fixation by suture [(1)]. Tissue glues have been found for over 20 years and used in surgery in various indications like skin wound closure, hemostasis during liver surgeries, and endoscopic treatment of gastroesophageal variceal bleeding. Usage of fibrin-based (Tissucol/Tisseel e Baxter Healthcare) and Nbutyl-2-cyanoacrylate-based adhesives (Glubran 2, GEM Srl) in inguinal hernioplasty was reported for the first time in the mid1990s [(5)].

In a multicenter RCT, the fibrin sealant was found to have a lower incidence of postoperative neuralgia than suture or staple fixation, with no difference in the rate of recurrence [(6)]. Following typical hernia repair methods, postoperative groin discomfort might include neuralgia, chronic inguinal pain of varying degrees, and paresthesia. Although they are not related, their genesis could be linked to the use of sutures, which could create a foreign-body reaction, or an inflammatory response triggered by the maneuvers and biomaterials. The use of cyanoacrylate (CA) to secure the mesh may result in better results and reduce tension on the pubis, muscles, and nerves [(7)].

This study aimed to compare the safety and efficacy of conventional sutures versus cyanoacrylate glue in mesh fixation during open inguinal hernioplasty.

## PATIENTS AND METHODS

This was a prospective, randomized controlled clinical trial conducted at the General Surgery Department, Al-Ahrar Teaching Hospital, during the period from January 2024 to January 2025 on 80 patients



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who were diagnosed with primary unilateral inguinal hernia. Follow-up was conducted at the outpatient surgical clinic.

**The inclusion criteria** of this study comprised adult patients aged 18 years or older who were diagnosed with primary unilateral inguinal hernia, were deemed fit to undergo elective open hernia repair under either regional or general anesthesia, and had provided informed written consent to participate in the study after a full explanation of the procedure and its possible outcomes.

**The exclusion criteria** included patients with recurrent or bilateral inguinal hernia, those presenting with complicated hernia such as incarceration, strangulation, or obstruction, as well as patients receiving immunosuppressive therapy or suffering from chronic systemic diseases known to impair wound healing, including uncontrolled diabetes mellitus, chronic renal failure, or liver cirrhosis. In addition, patients with a known allergy to cyanoacrylate glue or mesh material, and those who were unfit for anesthesia, were excluded from the study. Eligible patients were randomly allocated into two equal groups using a computer-generated randomization list. **Group A (Conventional Sutures Group)** included 40 patients in whom mesh fixation was achieved with non-absorbable polypropylene sutures, while **Group B (Cyanoacrylate Glue Group)** comprised 40 patients in whom mesh fixation was performed using medical-grade cyanoacrylate glue. Randomization results were kept in sealed opaque envelopes, opened immediately before surgery.

**Preoperative Assessment**

All patients were subjected to a thorough history taking and physical examination, in addition to routine laboratory investigations including complete blood count (CBC), renal function tests, and liver function tests, followed by a comprehensive pre-anesthetic evaluation to ensure fitness for surgery.

**Surgical Technique**

All operations were performed under spinal or general anesthesia with the patient in the supine position. A standard Lichtenstein tension-free mesh hernioplasty was used in both groups.

**Group A (Conventional Sutures):** The mesh was fixed to the inguinal ligament inferiorly and the conjoint tendon superiorly using interrupted non-absorbable polypropylene sutures (2/0). Care was taken to avoid injury to ilioinguinal and iliohypogastric nerves.

**Group B (Cyanoacrylate Glue):** The same mesh was fixed in position using drops of cyanoacrylate glue along the inferior and superior borders. A small drop was applied at intervals of 1–2 cm, and pressure was applied for 30–60 seconds to ensure firm adhesion. No sutures were used for fixation unless reinforcement was needed.

In both groups, the external oblique aponeurosis was closed, and the wound was closed in layers with a subcuticular skin stitch.

**Postoperative Care and Follow-Up**

Postoperative care included administration of standard analgesia with NSAIDs and/or paracetamol, with opioids given when required, in addition to prophylactic antibiotics according to hospital policy. Patients were encouraged to ambulate early, usually within 6–8 hours after surgery, and were discharged within 24–48 hours unless complications occurred. Follow-up visits were scheduled at 1 week for wound inspection and detection of early complications, and subsequently at 1 month, 3 months, and 6 months to monitor recovery and assess outcomes.

**Imaging Evaluation:**

Postoperative imaging was not routinely performed. However, ultrasonography was selectively used in patients who developed postoperative complications such as swelling, suspected seroma, hematoma, or recurrence. In cases with inconclusive clinical findings, a CT scan of the groin was performed to confirm or exclude mesh-related complications or recurrence.

**Outcome Measures**

The following outcomes were assessed and compared between the two groups:

Primary Outcomes were postoperative pain assessed using the Visual Analog Scale (VAS) at 12, 24, and 1 week, as well as at 1, 3 and 6 month and operative time recorded from skin incision to closure.

Secondary Outcomes were incidence of wound complications (hematoma, seroma, infection), time to return to normal daily activities, chronic groin pain at 3 and 6 months and recurrence rate at 6 months.

**Ethical considerations:**

**Approval for the study was obtained from the Research Ethical Committee, General Organization for Teaching Hospitals and Institutes (GOTHI) (HAH00022). Written informed consent was obtained from all patients after a full explanation of the surgical procedure, possible risks, and alternative methods of treatment. The study was conducted in accordance with the principles of the Declaration of Helsinki.**

***Statistical Analysis***

The collected data were computerized and statistically analyzed using the SPSS program (Statistical Package for the Social Sciences) version **27.0 (IBM, 2020)**. Quantitative data were presented as mean, standard deviation (SD), and range and were compared by independent t-test. Qualitative data were presented as frequency and percentage and were compared by Chi-square test or Fisher's exact test. P value $< 0.05$ was considered significant.

## RESULTS

There was no statistically significant difference between the glue and sutures groups regarding age, BMI, occupation, or comorbidities. This indicates that the two groups were well matched at baseline, minimizing potential confounding factors and ensuring that any differences observed in outcomes are likely attributable to the method of mesh fixation rather than demographic or clinical variations (Table 1).

**Table (1): Comparison of demographic data between the studied groups.**

| Variable | Variable | Glue group (n=40) | Sutures group (n=40) | P value |
|---|---|---|---|---|
| **Age (years)** | Mean ± SD | 41.3±7.7 | 42.8±7.8 | 0.387 |
| | Range | 27-58 | 22-56 | |
| **BMI (kg/m²)** | Mean ± SD | 27.5±2.8 | 27.4±3.1 | 0.836 |
| | Range | 21-35 | 22-34 | |
| **Occupation** | Manual | 9 (22.5%) | 10 (25.0%) | 0.296 |
| | Desk | 8 (20.0%) | 5 (12.5%) | |
| | Driver | 3 (7.5%) | 10 (25.0%) | |
| | Shopkeeper | 4 (10.0%) | 5 (12.5%) | |
| | Teacher | 7 (17.5%) | 5 (12.5%) | |
| | Other | 9 (22.5%) | 5 (12.5%) | |
| **Comorbidities** | None | 17 (42.5%) | 13 (32.5%) | 0.268 |
| | DM | 4 (10.0%) | 10 (25.0%) | |
| | HTN | 9 (22.5%) | 11 (27.5%) | |
| | DM+HTN | 6 (15.0%) | 5 (12.5%) | |
| | Smoker | 4 (10.0%) | 1 (2.5%) | |

SD: Standard Deviation, DM: Diabetes Mellitus, HTN: Hypertension.

The ASA score distribution showed no significant difference between the two groups. The most common score in both groups was ASA II. The mean ASA score was also not statistically significantly different between the two groups (Table 2).

**Table (2): ASA score between the studied groups.**

| Variable | Category | Glue group (n=40) | Sutures group (n=40) | P value |
|---|---|---|---|---|
| **ASA Score** | I | 13 (32.5%) | 6 (15.0%) | 0.095 |
| | II | 18 (45.0%) | 27 (67.5%) | |
| | III | 9 (22.5%) | 7 (17.5%) | |
| **ASA Score** | Mean ± SD | 1.9±0.7 | 2.0±0.6 | 0.404 |
| | Range | 1-3 | 1-3 | |

ASA Score: American Society of Anesthesiologists Score.

There was no statistically significant difference between the two groups regarding the type of anesthesia. However, the operating time was significantly shorter in the glue group compared to the sutures group (Table 3).

**Table (3): Operative and anesthesia data between the studied groups.**

| Variable | Variable | Glue group (n=40) | Sutures group (n=40) | P value |
|---|---|---|---|---|
| **Anesthesia Type** | Spinal | 32 (80.0%) | 28 (70.0%) | 0.439 |
| | General | 8 (20.0%) | 12 (30.0%) | |
| **Operating Time (min)** | Mean ± SD | 35.2±5.5 | 45.5±7.1 | **0.001** |
| | Range | 25-48 | 30-62 | |

SD: Standard Deviation, min: minutes.

Pain assessment using the Visual Analogue Scale (VAS) showed significantly lower scores in the glue group compared to the sutures group at all postoperative time points. These findings indicate that patients in the glue group experienced consistently less postoperative pain across all follow-up periods (Table 4).

**Table (4): VAS score between the studied groups**

| Variable | Variable | Glue group (n=40) | Sutures group (n=40) | P value |
|---|---|---|---|---|
| **VAS 12h** | Mean ± SD | 4.1±1.0 | 5.2±1.1 | **0.001** |
| | Range | 2-6 | 2-7 | |
| **VAS 24h** | Mean ± SD | 3.4±0.9 | 4.6±1.2 | **0.001** |
| | Range | 1-5 | 1-8 | |
| **VAS 1w** | Mean ± SD | 1.9±0.7 | 2.9±0.7 | **0.001** |
| | Range | 0-3 | 1-4 | |
| **VAS 1m** | Mean ± SD | 0.7±0.6 | 1.4±0.7 | **0.001** |
| | Range | 0-2 | 0-3 | |
| **VAS 3m** | Mean ± SD | 0.5±0.4 | 0.9±0.6 | **0.002** |
| | Range | 0-1 | 0-1 | |
| **VAS 6m** | Mean ± SD | 0.4±0.3 | 0.6±0.5 | **0.005** |
| | Range | 0-1 | 0-1 | |

VAS: Visual Analogue Scale, h: hours, w: weeks, m: month(s), SD: Standard Deviation.

Patients in the glue group returned to normal activity significantly earlier than those in the sutures group. Regarding early complications, the incidence of hematoma, early seroma, and early wound infection were not statistically significantly different between the two groups (Table 5).

**Table (5): Postoperative outcomes between the studied groups**

| Variable | Variable | Glue group (n=40) | Sutures group (n=40) | P value |
|---|---|---|---|---|
| **Return to Activity (days)** | Mean ± SD | 6.5±1.6 | 8.4±1.7 | **0.001** |
| | Range | 3-11 | 5-11 | |
| **Early Hematoma** | No | 38 (95.0%) | 39 (97.5%) | 1.0 |
| | Yes | 2 (5.0%) | 1 (2.5%) | |
| **Early Seroma** | No | 38 (95.0%) | 36 (90.0%) | 0.675 |
| | Yes | 2 (5.0%) | 4 (10.0%) | |
| **Early Wound Infection** | No | 40 (100.0%) | 38 (95.0%) | 0.494 |
| | Yes | 0 (0.0%) | 2 (5.0%) | |

D: Standard Deviation.

No statistically significant differences were observed between the two groups in terms of recurrence at 6 months, mesh infection, chronic pain at 6 months, and reoperation. This suggests that both fixation methods offered comparable long-term safety and recovery profiles (Table 6).

**Table (6): Follow-up outcomes between the studied groups**

| Variable | Variable | Glue group (n=40) | Sutures group (n=40) | P value |
|---|---|---|---|---|
| **Recurrence at 6m** | No | 40 (100.0%) | 39 (97.5%) | 1.0 |
| | Yes | 0 (0.0%) | 1 (2.5%) | |
| **Mesh Infection at 6m** | No | 40 (100.0%) | 39 (97.5%) | 1.0 |
| | Yes | 0 (0.0%) | 1 (2.5%) | |
| **Chronic Pain at 6m** | No | 39 (97.5%) | 37 (92.5%) | 0.615 |
| | Yes | 1 (2.5%) | 3 (7.5%) | |
| **Reoperation** | No | 40 (100.0%) | 38 (95.0%) | 0.494 |
| | Yes | 0 (0.0%) | 2 (5.0%) | |

6m: 6 months.

## DISCUSSION

One of the most striking findings of our study was the significantly shorter operating time in the glue group compared to the sutures group (35.2 ± 5.5 minutes vs 45.5 ± 7.1 minutes, p=0.001). This represents approximately a 23% reduction in operative time, which has important clinical and economic implications. Our results are consistent with multiple studies in the literature that have demonstrated time-saving benefits with tissue adhesives. **Yassin *et al.*** [8] aimed to clarify the efficacy and complications of cyanoacrylate glue and nonabsorbable sutures for mesh fixation in Lichtenstein hernia repair techniques. They reported that mean operation time in glue (group A) was 41.2 ± 5.1 min, while in sutures (group B) was 47.6 ± 4.9 min with statistically significantly higher mean operation time in the sutures group. The shorter operative time with glue can be attributed to the simplified technique of applying adhesive compared to the time-consuming process of placing and tying multiple sutures.

In agreement with our results, a large review by **Ladwa *et al.*** [9], found that glue groups showed a significant reduction in the operating time compared to the sutures group. Also, the study of **Chitrambalam and Chandrasekaran** [10] agrees with our finding. They found that sutures method takes a longer time (52.6±4.64) than the glue method (41.8±5.65) with statistically significant difference (p=0.00). **Arafa *et al.*** [6] support our findings as they found sutures mesh fixation take significantly longer duration than glue mesh fixation.

As well, **Arunkumar *et al.*** [11] aimed to compare the outcomes of mesh fixation using N-Hexyl cyanoacrylate glue versus conventional sutures in inguinal hernia repair. They reported that the mean procedure time was 65.86 ± 7.75 minutes for the glue group and 81.12 ± 9.50 minutes for the sutures group, with a statistically significant p-value of 0.0001. This is also consistent with **Zaidan *et al.*** [12] who reported a mean of operative time of 41.2 ± 5.1 mins for glue group and 47.6 ± 4.9 mins for suture groups, showing a statistically significant difference favoring the glue method.

Unlike our finding **Testini *et al.*** [13] in their study found in suture group that the mean duration of surgery was 54.5 min, while in the nbutyl-2- cyanoacrylate group was 54.2 min without any statistical significance.

The reduction in operative time has several important implications. First, it reduces the duration of anesthesia exposure, which may decrease anesthesia-related complications and improve patient safety. Second, shorter operative times increase operating room efficiency and potentially allow for more procedures to be performed, improving healthcare resource utilization. Third, reduced operative time may correlate with decreased tissue trauma and manipulation, which could contribute to better postoperative outcomes.

The type of anesthesia used (spinal vs general) showed no significant difference between groups, indicating that the choice of anesthesia did not confound our results. The predominance of spinal anesthesia in both groups (80% in glue group vs 70% in sutures group) reflects standard practice for inguinal hernia repair and is consistent with recommendations from enhanced recovery after surgery (ERAS) protocols for hernia repair [14].

Perhaps the most clinically significant finding of our study was the consistently lower pain scores in the glue group across all postoperative time points. At 12 hours postoperatively, patients in the glue group reported a mean VAS score of 4.1 ± 1.0 compared to 5.2 ± 1.1 in the sutures group (p=0.001). This difference persisted at 24 hours (3.4 ± 0.9 vs 4.6 ± 1.2), one week (1.9 ± 0.7 vs 2.9 ± 0.7), one month (0.7 ± 0.6 vs 1.4 ± 0.7), three months (0.5 ± 0.4 vs 0.9 ± 0.6), and even at six months (0.4 ± 0.3 vs 0.6 ± 0.5), with all differences being statistically significant.

These findings are consistent with the concept that suture fixation causes local tissue trauma, nerve entrapment, and inflammatory responses that contribute to acute and chronic pain. The reduction in postoperative pain with glue fixation has been well-documented in the literature. A meta-analysis by **Lin *et al.*** [15] found that tissue adhesive fixation resulted in significantly lower pain scores in both the early postoperative period and at long-term follow-up compared to suture fixation. The proposed mechanism involves the absence of nerve entrapment and reduced inflammatory response with glue fixation.

This is in line with **Yassin *et al.*** [8] who reported that there was statistically significant higher mean pain in the sutures group at 12 hr postoperative. Postoperative pain was much more common in the suture group than in the adhesive group.

In the study of **Chitrambalam and Chandrasekaran** [10], pain VAS scores showed a progressive decline with time with a significantly lower value in the glue group than in the sutures group. As well, **Arunkumar *et al.*** [11] reported that on day 3 post-operation, the VAS scores for pain were significantly low in glue group when compared to sutures groups. This is consistent with **Zaidan *et al.*** [12] who reported significantly lower VAS scores in the glue group at various postoperative intervals, including day 3.

The sustained reduction in pain scores through six months in our study is particularly noteworthy, as chronic postoperative inguinal pain (CPIP) is one of the most debilitating complications following hernia repair. Our finding that only 2.5% of glue group patients experienced

chronic pain at six months compared to 7.5% in the sutures group (though not statistically significant, p=0.608) suggests a potential benefit of glue fixation in reducing this complication. The relatively small sample size may have limited our ability to detect statistical significance in chronic pain rates, and larger studies would be valuable to confirm this trend.

Chronic postoperative inguinal pain is a complex multifactorial condition that significantly impacts quality of life. The International Association for the Study of Pain defines chronic pain as pain lasting beyond normal healing time, typically three months. Our finding that fewer glue patients experienced chronic pain is consistent with the hypothesis that avoiding nerve entrapment with sutures reduces long-term pain. **Sun *et al.*** [16] found that fixation-free or glue-based techniques were associated with lower rates of chronic pain compared to suture or tack fixation.

According to the degree of pain, **Yassin *et al.*** [8] found that in the cyanoacrylate group the overall pain was less in comparison with the other group which agrees with our study. The same result was realized by **Liu *et al.*** [17]. Their results showed that there was a lower incidence of chronic pain in the cyanoacrylate mesh fixation group. The Numerical Rating Scale was used to assess immediate postoperative pain within the first week of surgery, with a mean NRS score of 2.881.22 and 5.200.953 in glue and suture fixation, respectively, with a significant difference (p-value of 0.05).

The postoperative complications and chronic groin pain were statistically similar in both groups according to **Ladwa *et al.*** [9]**.**

The gradual decline in pain scores over time in both groups demonstrates the expected healing trajectory, but the consistently lower pain levels in the glue group suggest a fundamental difference in the tissue response to the fixation method. **Lionetti *et al.*** [18] proposed that the absence of foreign body reaction to suture material and the reduced tissue tension with glue fixation contribute to the improved pain profile.

In our study, patients in the glue group demonstrated significantly faster return to normal activities compared to the sutures group (6.5 ± 1.6 days vs 8.4 ± 1.7 days, p=0.001). This represents a 23% reduction in recovery time, which has important implications for patient satisfaction, return to work, and overall quality of life. Our findings are supported by the work of **Elkhateeb *et al.*** [1] who reported similar improvements in functional recovery with non-penetrating fixation methods. The faster recovery can be attributed to the combination of reduced postoperative pain and decreased tissue trauma associated with glue fixation.

In our study, the early complication rates were low and comparable between groups, which is reassuring regarding the safety of glue fixation. Hematoma occurred in 5% of glue patients versus 2.5% of sutures patients (p=1.0), seroma in 5% versus 10% (p=0.671), and early wound infection in 0% versus 5% (p=0.152). Although the glue group had no wound infections compared to two cases in the sutures group, this difference did not reach statistical significance, likely due to the small number of events. However, the trend toward fewer infections with glue is consistent with the hypothesis that reduced tissue trauma and the antimicrobial properties of cyanoacrylate may decrease infection risk. A study by **Waller *et al.*** [19] found that cyanoacrylate glue has inherent bacteriostatic properties that may contribute to reduced infection rates.

In accordance, **Yassin *et al.*** [8] reported that in terms of postoperative complications, glue (group A) revealed one case of postoperative seroma that resolved spontaneously without intervention, whereas sutures (group B) exhibited two cases of seroma and one case of superficial infection that responded well to local antibiotics. **Arafa *et al.*** [6] demonstrated in their study that scrotal edema and seroma were reduced in the glue fixation method (1.2 versus 3.8%, respectively).

Unlike our finding **Shah *et al.*** [20] discovered that there was a considerable difference between the two groups in terms of secondary sequelae, particularly scrotal edema, which was less in the cyanoacrylate group, as it happened in one patient only in the cyanoacrylate group and in 4 patients in the suture group. Also, hematoma and seroma occurred only in the suture group (3 patients seroma and 1 patient hematoma, P = 0.05).

The low overall complication rates in both groups reflect good surgical technique and appropriate patient selection. Our complication rates are comparable to or lower than those reported in large hernia registries, such as the Danish Hernia Database, [21] which provides external validation of our surgical quality.

In our study, at six months follow-up, the long-term safety and efficacy outcomes were excellent in both groups. Hernia recurrence, which is the ultimate measure of surgical success, occurred in only one patient (2.5%) in the sutures group and none in the glue group (p=1.0). This low recurrence rate is encouraging and compares favorably with international benchmarks. The European Hernia Society guidelines cite acceptable recurrence rates of less than 2% for primary inguinal hernia repair [22]**,** and both our groups meet this standard.

In our study, mesh infection occurred in one patient (2.5%) in the sutures group and none in the glue group (p=1.0). While rare, mesh infection is a devastating complication that often requires mesh removal and can lead to recurrence. The trend toward fewer mesh infections with glue, though not statistically significant in our study, is supported by the antimicrobial properties of

cyanoacrylate and the reduced tissue trauma during fixation [23].

The absence of recurrence in the glue group is particularly important as concerns have been raised about whether adhesive fixation provides adequate long-term mesh stability. Our results align with multiple studies demonstrating that glue fixation provides comparable or superior recurrence rates to suture fixation. A long-term follow-up study by **Kim-Fuchs *et al.*** [24] showed no difference in recurrence rates between glue and suture fixation, with both methods providing durable repair. The biomechanical properties of modern cyanoacrylate adhesives, combined with the tissue ingrowth that occurs over time, appear to provide sufficient mesh fixation strength.

In harmony, **Yassin *et al.*** [8] reported that in a 6-month follow-up, glue (group A) had one case of local numbness and one case of recurrence, while sutures (group B) had three cases with no significant difference between the two groups. In agreement, **Arafa *et al.*** [6] demonstrated that recurrence was recorded during their short-term follow-up and was reduced in the glue fixation group (3.8 versus 6.2% (P=0.719)).

In the study of **Chitrambalam and Chandrasekaran** [10], during the 6-month follow-up period, there were no intraoperative problems, seroma, wound infections, or ecchymoses, and no immediate recurrence. **Arunkumar *et al.*** [11] reported that recurrence rates at 6 months were also lower for the glue group (0%) compared to sutures (6%; p = 0.04).

Reoperation rates were low in both groups, with no reoperations in the glue group and two (5%) in the sutures group (p=0.152). The reasons for reoperation in the sutures group included one mesh infection requiring removal and one early recurrence. The absence of reoperations in the glue group, while not statistically significant, suggests that glue fixation does not increase the risk of complications requiring surgical intervention.

**Arafa *et al.*** [6] demonstrated that reoperations for hemorrhage are reduced in the glue fixation group during their short-term follow-up (0.0% versus 1.2%, respectively).

The cumulative evidence from our study demonstrates several important advantages of cyanoacrylate glue fixation over conventional sutures for mesh fixation in inguinal hernia repair. The significantly reduced operative time, lower postoperative pain, faster return to activities, and comparable safety profile make glue fixation an attractive alternative to traditional suture fixation.

The mechanism by which glue fixation reduces pain is multifactorial. First, it avoids penetration of the mesh through the underlying tissues, thereby preventing nerve entrapment and injury. Studies using nerve mapping during hernia repair have shown that suture placement commonly entraps or compresses nerves in the inguinal region, including the ilioinguinal, iliohypogastric, and genital branch of the genitofemoral nerve. Second, glue fixation reduces tissue tension and inflammatory response. The polymerization of cyanoacrylate creates a flexible bond that moves with the tissues rather than creating fixed points of tension. Third, the absence of foreign body material (sutures) that can serve as a nidus for chronic inflammation may reduce long-term pain [25].

From an economic perspective, the shorter operative time with glue fixation has important cost implications. Operating room time is one of the most expensive components of surgical care, and a 10-minute reduction in operative time translates to significant cost savings when multiplied across the many hernia repairs performed annually. Additionally, the faster return to work (approximately two days earlier) provides societal economic benefits through reduced productivity losses.

## Conclusions

Our study demonstrates that cyanoacrylate glue fixation is a safe, effective, and advantageous alternative to conventional sutures for mesh fixation in open inguinal hernia repair, offering reduced operative time, less postoperative pain, and faster recovery without compromising surgical outcomes.

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