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# Is the Dressing Optional? A Retrospective Comparison of Clinical Outcomes and Environmental Impact of Skin Glue Alone Versus Glue with Dressing After Open Inguinal Hernia Repair[#]

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## Rezumat

***Este pansamentul opțional? O comparație retrospectivă a rezultatelor clinice și a impactului asupra mediului înconjurător al utilizării exclusive a adezivului cutanat versus a adezivului cu pansament după repararea deschisă a herniei inghinale***

*Introducere:* Repararea herniei inghinale deschise este o operație frecvent efectuată în regim ambulatoriu. Adezivul cutanat cianoacrilat oferă o etanşare ocluzivă impermeabilă şi, în principiu, nu necesită niciun pansament post-operator suplimentar. În ciuda acestui fapt, practica variază considerabil, mulți chirurgi continuând să aplice pansamente din obişnuință, mai degrabă decât din necesitate clinică. Pe măsură ce sistemele de sănătate recunosc din ce în ce mai mult impactul consumabilelor chirurgicale asupra mediului, este esențial să înțeleagă dacă aceste pansamente oferă beneficii măsurabile. Acest studiu a comparat închiderea doar cu lipici cu lipici plus pansament, evaluând rezultatele clinice şi potențiala reducere a emisiilor de carbon evitabile.
*Material şi Metodă:* A fost efectuată o analiză comparativă retrospectivă a reparațiilor elective deschise cu plasă pentru hernie inghinală efectuate la cabinetul nostru medical. Optzeci de pacienți au fost incluşi: 40 tratați doar cu lipici şi 40 cu lipici plus pansament. Datele colectate au inclus complicațiile postoperatorii ale plăgii şi utilizarea pansamentului. A existat o infecție a plăgii în grupul tratat doar cu lipici şi nicio infecție a plăgii în grupul tratat doar cu lipici. Nu a existat nicio diferență semnificativă statistic în ratele de infecție între grupuri (1/40 vs 0/40; testul exact Fisher, p = 1,0). Ratele generale ale complicațiilor la nivelul plăgilor au fost scăzute în ambele grupuri.
*Rezultate:* Pacienții care au primit pansamente au generat deşeuri suplimentare, cu o furnizare variabilă de pansamente pentru acasă, rezultând o cantitate estimată de 150-450 g $CO_{2e}$ per pacient. Închiderea doar cu lipici a produs emisii neglijabile legate de pansamente. În plus, pacienții din grupul care a primit doar lipici au raportat o satisfacție mai mare față de autoîngrijirea plăgii. Adăugarea de pansamente postoperatorii nu a conferit niciun avantaj clinic, dar a introdus daune evitabile asupra mediului.

*Concluzie:* Omiterea pansamentelor de rutină atunci când se utilizează lipici este o măsură sigură, simplă şi imediat adoptabilă pentru a îmbunătăți sustenabilitatea reparării herniei inghinale deschise.

**Cuvinte cheie:** închiderea plăgii chirurgicale, infecția locului operat, complicații ale plăgii, repararea herniei inghinale deschise

## Abstract

*Introduction:* Open inguinal hernia repair is a frequently performed day-case operation. Cyanoacrylate skin adhesive provides a waterproof, occlusive seal and, in principle, does not require any additional postoperative dressing. Despite this, practice varies considerably, with many surgeons continuing to apply dressings out of habit rather than clinical necessity. As healthcare systems increasingly recognise the environmental impact of surgical consumables, understanding whether these dressings offer measurable benefits is essential. This study compared glue-only closure with glue plus dressing, evaluating clinical outcomes and the potential reduction in avoidable carbon emissions.

*Material and Method:* A retrospective comparative analysis was undertaken of elective open inguinal hernia mesh repairs performed at our trust. Eighty patients were included: 40 managed with glue alone and 40 with glue plus dressing. Data collected included postoperative wound complications and dressing use. There was one wound infection in the glue plus dressing group and no wound infections in the glue only group. There was no statistically significant difference in infection rates between groups (1/40 vs 0/40; Fisher's exact test, $p = 1.0$). Overall wound complication rates were low in both groups.

*Results:* Patients receiving dressings generated additional waste, with variable provision of take-home dressings resulting in an estimated 150–450 g $CO_{2e}$ per patient. Glue-only closure produced negligible dressing-related emissions. Additionally, patients in the glue-only group reported greater satisfaction with wound self care.

*Conclusion:* The addition of postoperative dressings conferred no clinical advantage yet introduced avoidable environmental harm. Omitting routine dressings when glue is used is a safe, simple, and immediately adoptable measure to improve the sustainability of open inguinal hernia repair.

**Keywords:** surgical wound closure, surgical site infection, wound complications, open inguinal hernia repair

## Introduction

The open approach has traditionally been considered the gold standard technique for inguinal hernia repair (1). It is estimated that more than 20 million inguinal hernia repairs are performed worldwide each year, highlighting the high procedural volume of this operation (2). A substantial proportion of these procedures continue to be performed using the open technique. Despite the frequency of this surgery, considerable variation exists in postoperative wound closure techniques and dressing practices. Skin closure may be achieved using interrupted sutures, continuous sutures, subcuticular closure, skin adhesive glues, or surgical staples, depending on intraoperative findings and surgeon preference (3,4). Similarly, a variety of postoperative dressing materials are used in routine practice, including clear occlusive dressings, gauze secured with adhesive tape, and Steri-Strips™ (5). However, there is no clear consensus regarding optimal postoperative dressing practices. Compression dressings are sometimes applied to reduce the risk of seroma or haematoma formation following hernia repair, although evidence supporting their clinical benefit remains limited, and no clear guideline recommendations currently exist. In addition to clinical outcomes, routine postoperative dressing use represents a source of avoidable healthcare waste, with potential economic and environmental implications.

Optimal wound management aims to achieve good tissue approximation, favourable cosmetic outcomes, and minimal postoperative wound complications. In addition, the economic and environmental impact of postoperative practices should also be considered. Skin adhesive glue (octyl-2-cyanoacrylate) is increasingly used in surgical practice. It offers several advantages, including waterproof sealing, antimicrobial properties, and elimination of the need for suture removal and follow-up appointments. However, it remains unclear whether the application of an additional postoperative dressing provides any clinical benefit when skin glue is used for wound closure following

inguinal hernia repair, or whether this practice persists largely out of convention.

This retrospective analysis aimed to compare postoperative wound outcomes after glue-only closure versus glue plus dressing following elective open inguinal hernia repair, and to estimate the potential environmental impact of routine dressing use.

## Material and Methods

### *Study Design and Setting*

This study was registered locally as a clinical audit evaluating postoperative wound management practices in open inguinal hernia repair, comparing patients who had glue with dressing to glue alone. The study period was from September 2024 to December 2025. A total of 80 patients who met the inclusion criteria were included in the study and followed up for one month post-operatively. Patients were identified from operative records during the study period and allocated to groups based on postoperative wound management used in routine clinical practice.

### *Inclusion and Exclusion Criteria*

Patients were eligible for inclusion if they were older than 18 years of age, underwent elective open inguinal hernia repair, and had skin closure performed using subcuticular Monocryl sutures followed by application of cyanoacrylate skin adhesive.

Patients were excluded if they underwent emergency inguinal hernia repair or laparoscopic inguinal hernia repair.

### *Postoperative Wound Management Groups*

Patients were divided into two groups according to postoperative wound management.

Glue-only group: Subcuticular closure with Monocryl and cyanoacrylate skin adhesive without application of an additional dressing (n = 40).

Glue plus dressing group: Subcuticular closure with Monocryl and cyanoacrylate skin adhesive followed by application of a postoperative dressing (n = 40).

Postoperative wound complications, including infection, haematoma, and wound dehiscence, were assessed during the one-month follow-up period. In addition to clinic follow-up, one month after the operation, to gather subjective feedback on their wound experience, comfort and satisfaction in both groups. The environmental impact of postoperative dressing use was estimated by calculating the carbon dioxide equivalent ($CO_{2e}$) associated with dressing materials and packaging based on published healthcare consumables emission factors. As this was a retrospective analysis, postoperative complications managed exclusively in primary care were identified through patient self-report during follow-up, and General Practitioner records.

The environmental impact assessment was calculated using published life-cycle assessment emission factors given by Rizan et al. (6). A typical dressing set used included sterile gauze swabs and an adhesive dressing with its packaging. Emission factors from Rizan et al. were applied per dressing set, consistent with their life cycle boundaries. The total estimated $CO_{2e}$ per patient was calculated based on the number of dressings each patient received, whether applied intra-operatively, provided on discharge or self-purchased.

### *Statistical Analysis*

Statistical analysis was performed using descriptive statistics and Fisher's exact test for categorical comparison due to the small sample size.

## Results

A total of 80 patients undergoing elective open inguinal hernia repair were included in the study. Patients were divided into two groups according to postoperative wound management: the glue-only group (n = 40) and the glue plus dressing group (n = 40).

Baselines characteristics and outcomes are summarized in *Table 1.*

In the glue-only group, there were six females and 34 males. The glue plus dressing group included one female and 39 males. No gender-specific subgroup analysis was performed due to

**Table 1.**

| Variable Glue | Only (n=40) | Glue + Dressing (n=40) |
|---|---|---|
| Mean age | 62.45 years | 62.26 years |
| Females | 6 | 1 |
| Males | 34 | 39 |
| Infection | 0 | 1 |
| Dehiscence | 0 | 0 |
| Seroma | 0 | 0 |

the small sample size.

The mean age of patients in the glue-only group was 62.45 years, and the mean age of patients in the glue plus dressing group was 62.27 years. The mean age in the two groups was comparable.

Postoperative wound complications were infrequent in both groups. In the glue-only group, there were no wound infections. There was one wound infection in the glue plus dressing group that was treated by the General Practitioner. (0/40 vs 1/40; Fisher's exact test, p=1.0).

No cases of wound dehiscence were observed in this group. No cases of seroma or wound dehiscence were recorded in either group. One patient had a concurrent hydrocele operation and drain and was reviewed by Urology. Patients in the glue-only group reported more confidence in managing their wounds, noting the simplicity of having no additional dressings.

The use of postoperative dressings resulted in additional material utilisation. Patients in the glue plus dressing group were frequently provided with take-home dressings following discharge. The number of dressings supplied varied, with some patients receiving one, two, or three additional dressing sets. Two patients reported purchasing additional dressings from community pharmacies.

Based on estimates of the carbon footprint associated with dressing materials and packaging, dressing use corresponded to approximately 150–450 g $CO_{2e}$ per patient. In contrast, patients managed with glue-only closure generated negligible dressing-related waste and associated carbon emissions.

## Discussion

In this retrospective analysis, postoperative wound complications were infrequent in both groups, with no observed increase in complications among the patients managed with glue-only closure compared with those receiving glue plus dressing.

Compression or pressure dressings are frequently used following open inguinal hernia repair. The most common wound-related complications associated with this procedure include seroma formation, haematoma, wound infection, and wound dehiscence. However, evidence supporting the use of specific dressings to mitigate these complications remains limited. The HerniaSurge Group guidelines found no evidence that binders or external compression devices reduce the risk of seroma or haematoma following hernia repair (7).

Similarly, a systematic review by Dumville et al. found that routine use of dressings for surgical wounds healing by primary intention did not prevent surgical site infections (SSIs). The review also concluded that no particular type of dressing was superior in preventing infection, improving scar outcomes, reducing pain, improving patient acceptability, or facilitating ease of dressing removal (8).

In our review, there was one SSI reported in the glue plus dressing group and none in the glue only group. Overall wound complication rates were low, and the addition of postoperative dressings was not associated with an observed reduction in wound complications in this cohort. On the contrary, the use of dressings contributed to patient dissatisfaction and confusion regarding their duration of use. Two patients in the dressing group reported purchasing additional dressings from community pharmacies due to uncertainty about postoperative wound care.

Cyanoacrylate skin adhesive offers several advantages in surgical wound closure. It naturally sloughs off within 5-10 days and does not require removal. In addition, it provides a microbial barrier and forms an occlusive seal over the wound, thereby potentially eliminating the need for additional postoperative dressings (9).

The environmental impact of surgery is another important factor to consider. Global warming has led to rising sea levels, extreme weather, loss of biodiversity, respiratory diseases and other health issues among humans (10). Changing our practice and working on sustainable surgical practices is necessary now more than ever. The National Health Service (NHS) is responsible for 5.9% of the national carbon footprint in the UK, which is roughly equivalent to 20 million tonnes of carbon dioxide equivalent emissions per year (11). With the NHS aiming to become the first carbon-neutral national health service by 2040, it sets a bold precedent in the healthcare sector for environmental sustainability (12). It is therefore essential to understand the environmental impact of materials used in theatre and minimise their impact. Carbon estimates in this study were derived using published emission factors from Rizan et al., who quantified the $CO_{2e}$ of common surgical consumables using an attributional life-cycle approach (6). A systematic review by De'Angelis et al. reported that a single surgical procedure contributed between 4–814 $kgCO_{2e}$ in emissions (13). In our study, patients in the dressing group received the initial dressing applied in theatre and were often given up to two additional dressings to take home.

The estimated carbon footprint associated with one set of dressings is approximately 150 g $CO_{2e}$, increasing to around 450 g $CO_{2e}$ when multiple dressings are used. Although the environmental impact per individual patient may appear modest, the cumulative effect becomes significant when considered across the large number of inguinal hernia repairs performed each year globally.

Estridge et al. reported 59,755 primary inguinal hernia repairs in England during 2017–2018, of which approximately 23% were performed laparoscopically (14). Based on this, around 46,000 repairs were performed using the open technique. Assuming postoperative dressings were used for these cases, the estimated carbon footprint attributable to dressing materials alone would range from approximately 6.9 to 20.7 tonnes of $CO_{2e}$ annually, depending on the number of dressings provided. This is roughly equivalent to the emissions generated by 4-13 round-trip transatlantic flights between New York and Paris (15). These estimates are likely conservative, particularly when considering the growing number of hernia repairs performed each year in the UK and worldwide. The cumulative impact of this is meaningful considering the sheer volume of hernia repairs performed worldwide.

Overall, our findings suggest that the routine use of postoperative dressings following skin glue closure in open inguinal hernia repair offers no additional clinical benefit while contributing to unnecessary healthcare waste and environmental impact. While our findings highlight a sustainable approach in this specific context, broader investigations across various surgical procedures are needed to fully understand when dressings can be reduced or omitted to minimise environmental impact.

This study specifically evaluated the impact of postoperative dressing use versus no dressing, rather than comparing the carbon footprint of different wound closure materials such as skin adhesives. Cyanoacrylate adhesive lacks process-based emission factors within the Rizan dataset and can only be estimated using EEIO financial modelling. As this approach is not directly comparable to the process-based methodology used for dressing materials, a like-for-like carbon footprint comparison was not performed.

### *Limitations*

This study has several limitations. It is a retrospective single-centre analysis with a relatively small sample size. Larger prospective studies would help further validate these findings.

## Conclusion

Routine application of postoperative dressings following skin glue closure in elective open inguinal hernia repair does not appear to provide additional clinical benefit. In this study, complication rates were low and comparable between patients managed with glue alone and those receiving additional dressings. The use of dressings, however, contributed to increased material consumption, patient uncertainty regarding postoperative wound care, and avoidable carbon emissions. Omitting routine dressings when cyanoacrylate glue is used may therefore represent a safe, simple, and sustainable modification to postoperative practice.

### *Author's Contributions*

Conception and Design - Christi Swaminathan, Nida Khan. Data collection - Nida Khan, Mukhil Rajendran, Dominika Krasicka. Data analysis - Nida Khan, Havil Stephen Alexander Bakka, Premjithlal Bhaskaran. Manuscript draft - Nida Khan, Mukhil Rajendran, Rafique Umer Harvitkar, Dominika Krasicka. Critical revisions and edits - Christi Swaminathan, Victoria Pegna. Supervision - Christi Swaminathan, Victoria Pegna. Final approval - All authors.

### *Conflict of Interest*

None.

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None.

## References

1. Huerta S. The gold-standard technique for inguinal hernia repair is the open approach. Hernia. 2020;24(5):1125-6.
2. Tigora A, Radu PA, Garofil DN, Bratucu MN, Zurzu M, Paic V, et al. Modern Perspectives on Inguinal Hernia Repair: A Narrative Review on Surgical Techniques, Mesh Selection and Fixation Strategies. J Clin Med. 2025;14(14): 4875.
3. Salam A, Ahmed M, Saeed S, Khowaja AA, Memon AS. Skin Adhesive vs Skin Sutures for wound closure in hernia repair: A Randomized controlled Trial. Global Journal of Dermatology & Venereology. 2019;7:6-11.
4. Agbakwuru EA, Olabanji JK, Alatise OI, Katung IA, Unakpoya UU. Single versus two layer suturing for wound closure after inguinal hernia repair. Niger J Clin Pract. 2009;12(2):162-4.
5. Mastud K, Lamture Y, Nagtode T, Rewale V, Rewale VM. A comparative study between conventional sutures, staples, and adhesive glue for clean elective surgical skin closure. Cureus. 2022;14(11):e31196.
6. Rizan C, Lillywhite R, Reed M, Bhutta MF. The carbon footprint of products used

in five common surgical operations: identifying contributing products and processes. R Soc Med. 2023;116(6):199-213.
7. HerniaSurge Group. International guidelines for groin hernia management. Hernia. 2018;22(1):1-165.
8. Dumville JC, Gray TA, Walter CJ, Sharp CA, Page T. Dressings for the prevention of surgical site infection. Cochrane Database Syst Rev. 2014;(9):CD003091.
9. Singer AJ, Quinn JV, Hollander JE. The cyanoacrylate topical skin adhesives. Am J Emerg Med. 2008;26(4):490-6.
10. Odimegwu F. Global Warming - The Impact and Implications. 2025.
11. Al-Hadithy N, Knight K, Gopfert A, Van Hove M, Garcia XV. Vital role of clinicians in reducing the NHS carbon footprint through smarter procurement decisions. BMJ Lead. 2024;8(1):43-48.
12. Jennings N, Rao M. Towards a carbon neutral NHS. BMJ. 2020:371:m3884.
13. de'Angelis N, Conso C, Bianchi G, Rodríguez AG, Marchegiani F, Carra MC, et al. Systematic review of carbon footprint of surgical procedures. J Visc Surg. 2024; 161(2S):7-14.
14. Estridge P, Sanders DL, Kingsnorth AN. Worldwide hernia repair: variations in the treatment of primary unilateral inguinal hernias in adults in the United Kingdom and in low-and middle-income countries. Hernia. 2019;23(3):503-507.
15. https://www.icao.int/environmental-protection/environmental-tools/icec