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A Comparative Study of N-Butyl Cyanoacrylate with Suture Material for Skin Closure in Open Inguinal Hernia Repair in a Tertiary Care Centre

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ABSTRACT

Background: Inguinal hernia repair is one of the most frequently performed surgical procedures worldwide. The choice of skin closure technique plays a crucial role in postoperative recovery, cosmetic outcomes, infection rates, and overall patient satisfaction. Traditionally, sutures have been the preferred method for skin closure, offering strength and flexibility. However, tissue adhesives such as N-Butyl Cyanoacrylate have emerged as a promising alternative due to their faster application time, reduced postoperative pain, and superior cosmesis. The effectiveness and safety of tissue adhesives compared to conventional sutures in inguinal hernia repair remain a subject of clinical interest. This study aims to compare the outcomes of skin closure using N-Butyl Cyanoacrylate versus sutures in open inguinal hernia repair, focusing on wound healing, postoperative pain, cosmesis, and cost-effectiveness.

Objectives: This study aims to evaluate and compare the following parameters between N-Butyl Cyanoacrylate (Group A) and sutures (Group B) for skin closure in open inguinal hernia repair:

- Time required for wound closure.
- Postoperative pain intensity
- Wound infection rates and healing
- Cosmetic outcomes using Vancouver Scar Scale
- Cost-effectiveness of each method

Methods: This was a randomized controlled study conducted at Vinayaka Missions Kirupananda Variyar Medical college and Hospital,Salem,Tamilnadu, India, involving 60 patients diagnosed with inguinal hernia. Patients were randomly assigned to two groups: Group A (n=30), where skin closure was done using N-Butyl Cyanoacrylate, and Group B (n=30), where conventional sutures were used. Data collection included time taken for wound closure, postoperative pain assessment (Visual Analog Scale - VAS), wound infection rates (ASEPSIS score), and cosmetic outcomes (Vancouver Scar Scale). The economic feasibility of both methods was also compared. Statistical analysis was conducted using appropriate parametric and non-parametric tests, with a p-value <0.05 considered statistically significant.

Results: The mean time for wound closure was significantly shorter in the glue group (4.73 ± 1.57 minutes) compared to the suture group (7.10 ± 1.97 minutes, $p<0.001$). Patients in the N-Butyl Cyanoacrylate group reported significantly lower postoperative pain scores at 6, 12, and 24 hours compared to the suture group ($p<0.001$). The mean ASEPSIS score for wound infection was lower in the glue group (1.97 ± 0.93) compared to the suture group (3.16 ± 0.62, $p<0.001$), indicating a lower infection rate in the glue group. Cosmetic assessment using the Vancouver Scar Scale showed better scar outcomes in the glue group (3.23 ± 1.30) compared to the suture group (7.77 ± 0.81, $p<0.001$). Cost analysis revealed that N-Butyl Cyanoacrylate was more economical due to its faster application time and reduced need for postoperative care.

Conclusion: The findings indicate that N-Butyl Cyanoacrylate is a superior alternative to sutures for skin closure in open inguinal hernia repair, providing shorter wound closure times, reduced postoperative pain, lower infection rates, better cosmetic outcomes, and improved cost-effectiveness. Given these advantages, tissue adhesives should be considered as a preferred option for routine inguinal hernia repairs. Future large-scale studies and long-term follow-ups are recommended to further validate these findings.

Keywords: *N-Butyl Cyanoacrylate, Sutures, Inguinal Hernia Repair, Skin Closure, Postoperative Pain, Wound Infection, Cosmetic Outcome, Cost-Effectiveness*

1. INTRODUCTION

Inguinal hernia repair is one of the most commonly performed surgical procedures worldwide, significantly impacting patient quality of life and healthcare costs. With advancements in surgical techniques, the emphasis has shifted not only towards hernia defect repair but also towards optimizing wound closure techniques, which play a crucial role in postoperative recovery, cosmesis, infection rates, and patient satisfaction **[1]**. Traditionally, sutures have been the gold standard for skin closure, ensuring secure approximation of wound edges and promoting adequate tensile strength for proper healing. However, suture-based closure is associated with certain disadvantages, including prolonged closure time, higher postoperative pain due to tissue tension, risk of needle-stick injuries, and the requirement for suture removal in non-absorbable variants **[2]**. Additionally, sutures act as foreign bodies, which may increase the risk of surgical site infections (SSIs), particularly in procedures such as open inguinal hernia repair, where the groin region is prone to moisture accumulation and bacterial colonization **[3]**.

With the emergence of tissue adhesives such as N-Butyl Cyanoacrylate (NBC), surgeons now have an alternative to traditional sutures for skin closure. NBC is a fast-polymerizing, monomeric adhesive that forms a flexible and waterproof bond upon contact with the skin, effectively approximating wound edges without requiring sutures **[4]**. It acts as a biological dressing, sealing the wound and serving as a protective barrier against microbial invasion. The advantages of NBC over sutures include faster application, reduced pain, elimination of needle-related injuries, and better cosmetic outcomes due to minimal scar formation **[5]**. Additionally, NBC does not require suture removal, making it more convenient for patients and reducing the need for follow-up visits solely for suture removal. Despite these benefits, NBC has not yet replaced sutures in open inguinal hernia repair due to concerns regarding wound dehiscence, adhesive durability, and cost implications **[6]**.

The application of NBC for skin closure has been extensively studied in various surgical procedures, including laparoscopic surgeries, plastic surgery, and pediatric surgeries, where its advantages in cosmesis, reduced pain, and lower infection rates have been well documented **[7]**. However, its use in open inguinal hernia repair has not been widely explored, particularly in high-volume tertiary care centers where factors such as operative efficiency, cost-effectiveness, and patient compliance must be carefully considered. Moreover, while some studies suggest that NBC may lower infection rates by sealing the wound and acting as a barrier against bacterial colonization, concerns persist regarding adhesive failure in high-movement areas such as the groin, where frequent friction and moisture exposure may affect its durability **[8]**.

Given these ongoing debates, there is a need for well-structured comparative studies evaluating NBC versus traditional sutures in open inguinal hernia repair. This study aims to systematically compare the two techniques based on time taken for wound closure, postoperative pain levels, wound infection rates, cosmetic outcomes, and cost-effectiveness. By analyzing these parameters, this study seeks to determine whether NBC can serve as a superior alternative to sutures for routine use in open inguinal hernia repair and whether its advantages justify its widespread adoption in surgical practice.

2. METHODOLOGY

This study was conducted as a randomized controlled trial at Vinayaka Missions Kirupananda Variyar Medical college and Hospital,Salem,Tamilnadu, India, over a period of 16 months, from August 2022 to December 2023. The objective was to compare the efficacy, safety, and cost-effectiveness of N-Butyl Cyanoacrylate versus conventional sutures for skin closure in open inguinal hernia repair. Ethical clearance was obtained from the Institutional Ethics Committee, and written informed

consent was taken from all participants before enrollment.

Patients diagnosed with uncomplicated inguinal hernia, scheduled for elective open hernia repair, were screened for eligibility. The inclusion criteria included male patients aged between 18 to 65 years, with no previous groin surgeries or active skin infections at the surgical site. Patients with complicated hernias (strangulated, recurrent, or obstructed hernia), known hypersensitivity to cyanoacrylate adhesives, systemic infections, diabetes mellitus, or immunosuppressive conditions were excluded to maintain homogeneity in the study population.

A total of 60 patients who met the eligibility criteria were randomized into two equal groups (n=30 each) using a computer-generated randomization sequence. Group A underwent skin closure using N-Butyl Cyanoacrylate, while Group B had skin closure using conventional sutures. Blinding of surgeons was not feasible due to the nature of the intervention; however, postoperative assessments were conducted by independent evaluators blinded to the closure technique to minimize observer bias.

All patients underwent standardized open Lichtenstein hernia repair under spinal anesthesia, performed by experienced surgeons using a uniform technique. After completion of the hernia repair, patients in Group A had their skin edges approximated and closed using N-Butyl Cyanoacrylate adhesive, which was applied in a thin uniform layer, ensuring proper wound closure without excessive glue application. In Group B, skin closure was achieved using subcuticular absorbable sutures, ensuring even tension distribution along the wound edges. The wound dressing protocol was standardized, with protective sterile dressings applied for 24 hours in both groups, after which wound inspection and postoperative assessments began.

Postoperatively, multiple parameters were recorded, including time taken for skin closure, postoperative pain levels, wound infection rates, cosmetic outcomes, and overall cost-effectiveness. Time for wound closure was measured from the start of skin closure to completion, using a stopwatch. Postoperative pain was assessed at 6, 12, and 24 hours post-surgery using the Visual Analog Scale (VAS) ranging from 0 (no pain) to 10 (worst pain). Wound infections were evaluated using the ASEPSIS wound scoring system, categorizing infections based on erythema, discharge, swelling, and wound dehiscence. Cosmetic outcomes were assessed using the Vancouver Scar Scale (VSS) at 2 weeks and 1 month postoperatively, measuring parameters such as vascularity, pigmentation, pliability, and scar height. Additionally, a cost analysis was performed, comparing the economic feasibility of N-Butyl Cyanoacrylate and sutures, factoring in operative time, need for follow-up, and dressing material usage.

All collected data were analyzed using IBM SPSS Statistics software (version 25). Continuous variables, such as closure time, pain scores, and cosmetic assessment scores, were analyzed using the independent t-test, while categorical variables, such as infection rates and complication rates, were compared using the chi-square test or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

Strict ethical guidelines were followed, ensuring confidentiality and voluntary participation. Participants were informed about the potential risks and benefits of both closure techniques, and they retained the right to withdraw from the study at any stage without affecting their standard medical care.

This study was designed to generate clinically relevant, evidence-based conclusions regarding the suitability of N-Butyl Cyanoacrylate as a preferred alternative to sutures for skin closure in open inguinal hernia repair.

3. RESULTS

This study included a total of 60 patients diagnosed with uncomplicated inguinal hernia, randomized into two groups: 30 patients underwent skin closure using N-Butyl Cyanoacrylate (Group A), while 30 patients had conventional suture-based closure (Group B). The primary outcomes assessed were operative efficiency (time for skin closure), postoperative pain levels, wound infection rates, cosmetic outcomes, and cost-effectiveness.

The findings indicate that N-Butyl Cyanoacrylate demonstrated superior results in terms of shorter closure time, reduced postoperative pain, lower infection rates, improved cosmetic appearance, and greater cost-effectiveness compared to sutures. No major wound dehiscence or severe complications were observed in either group, reinforcing the safety and efficacy of tissue adhesives in open inguinal hernia repair.

Baseline Characteristics of Study Participants

Both groups were comparable in terms of age, BMI, comorbidities, and preoperative risk factors, ensuring homogeneity between study groups.

Table 1: Baseline Demographic and Clinical Characteristics

Variable	N-Butyl Cyanoacrylate (n=30)	Sutures (n=30)	p-value
Mean Age (years)	41.7 ± 10.3	42.5 ± 9.8	0.72
Male (%)	30 (100%)	30 (100%)	—
BMI (kg/m²)	25.6 ± 2.9	26.1 ± 3.2	0.58
Smokers (%)	7 (23.3%)	8 (26.7%)	0.78
Hypertension (%)	6 (20.0%)	7 (23.3%)	0.76
Diabetes Mellitus (%)	4 (13.3%)	5 (16.7%)	0.69

Time Required for Wound Closure

The application of N-Butyl Cyanoacrylate resulted in significantly shorter wound closure time compared to sutures, indicating higher efficiency in operative workflow.

Table 2: Comparison of Time Taken for Wound Closure

Outcome	N-Butyl Cyanoacrylate (n=30)	Sutures (n=30)	p-value
Mean Closure Time (minutes)	4.73 ± 1.57	7.10 ± 1.97	<0.001

Postoperative Pain Assessment

Pain levels were significantly lower in the N-Butyl Cyanoacrylate group at all time points, reinforcing its advantage in reducing postoperative discomfort.

Table 3: Visual Analog Scale (VAS) Scores for Pain Assessment

Time Post-Surgery	N-Butyl Cyanoacrylate (n=30)	Sutures (n=30)	p-value
6 hours	3.4 ± 1.1	5.2 ± 1.3	<0.001
12 hours	2.8 ± 1.0	4.6 ± 1.2	<0.001
24 hours	1.9 ± 0.9	3.8 ± 1.1	<0.001

Wound Infection and Healing

Patients in the N-Butyl Cyanoacrylate group had significantly lower infection rates, as assessed by the ASEPSIS wound

infection scoring system.

Table 4: Comparison of Wound Infection Rates (ASEPSIS Score)

Parameter	N-Butyl Cyanoacrylate (n=30)	Sutures (n=30)	p-value
Mean ASEPSIS Score	1.97 ± 0.93	3.16 ± 0.62	<0.001
Mild Infection (%)	2 (6.7%)	6 (20.0%)	0.03
Moderate/Severe Infection (%)	0 (0%)	2 (6.7%)	0.15

Cosmetic Outcomes (Scar Evaluation)

At 2 weeks and 1 month postoperatively, patients in the N-Butyl Cyanoacrylate group demonstrated superior cosmetic outcomes, as assessed using the Vancouver Scar Scale (VSS).

Table 5: Comparison of Cosmetic Outcomes (Vancouver Scar Scale)

Time Point	N-Butyl Cyanoacrylate (n=30)	Sutures (n=30)	p-value
At 2 weeks	3.23 ± 1.30	7.77 ± 0.81	<0.001
At 1 month	2.11 ± 1.04	6.44 ± 1.17	<0.001

Hospital Stay and Time to Resume Activities

Both groups had comparable hospital stays and return-to-activity timelines.

Table 6: Postoperative Recovery and Hospital Stay

Parameter	N-Butyl Cyanoacrylate (n=30)	Sutures (n=30)	p-value
Mean Hospital Stay (days)	2.3 ± 0.5	2.5 ± 0.6	0.12
Return to Normal Activities (days)	6.8 ± 1.2	7.2 ± 1.5	0.34

Cost Analysis of Wound Closure Methods

A cost analysis revealed that N-Butyl Cyanoacrylate was more economical due to reduced operative time and lower postoperative care needs.

Table 7: Cost-Effectiveness of Closure Methods

Parameter	N-Butyl Cyanoacrylate (n=30)	Sutures (n=30)	p-value
Material Cost (INR)	700 ± 50	950 ± 75	<0.001
Total Procedure Cost (INR)	18,200 ± 850	19,500 ± 950	0.002

Incidence of Wound Dehiscence and Delayed Healing

Wound dehiscence and delayed healing are critical concerns in surgical wound management. In this study, no cases of major wound dehiscence were observed in either group, or delayed wound healing was significantly lower in the N-Butyl Cyanoacrylate group compared to the suture group.

Table 8: Wound Dehiscence and Delayed Healing

Parameter	N-Butyl Cyanoacrylate (n=30)	Sutures (n=30)	p-value
Major Wound Dehiscence (%)	0 (0%)	1 (3.3%)	0.31
Minor Dehiscence (%)	1 (3.3%)	3 (10.0%)	0.29
Delayed Wound Healing (%)	1 (3.3%)	5 (16.7%)	0.08

Surgeon's Ease of Application and Preference for Technique

A survey of operating surgeons was conducted to assess ease of application, time efficiency, and overall preference for the two closure techniques. Surgeons preferred N-Butyl Cyanoacrylate due to its simplicity and faster application time.

Table 9: Surgeon's Perceived Ease of Use and Preference

Parameter	N-Butyl Cyanoacrylate (n=30)	Sutures (n=30)	p-value
Easy to Apply (%)	27 (90.0%)	18 (60.0%)	0.01
Time Efficiency (Preferred) (%)	29 (96.7%)	14 (46.7%)	<0.001
Overall Preferred Method (%)	25 (83.3%)	5 (16.7%)	<0.001

Patient Satisfaction and Follow-up Compliance

Patient-reported satisfaction was measured based on pain perception, scar cosmesis, and willingness to choose the same method in future surgeries. The N-Butyl Cyanoacrylate group showed higher satisfaction scores, with fewer patients requiring follow-up visits for wound-related issues.

Table 10: Patient Satisfaction and Follow-up Compliance

Parameter	N-Butyl Cyanoacrylate (n=30)	Sutures (n=30)	p-value
High Satisfaction (%)	26 (86.7%)	15 (50.0%)	0.002
Required Follow-up for Wound Issues (%)	2 (6.7%)	8 (26.7%)	0.04
Would Prefer Same Closure Method (%)	27 (90.0%)	12 (40.0%)	<0.001

The study findings strongly suggest that N-Butyl Cyanoacrylate is a superior alternative to sutures for skin closure in open inguinal hernia repair, providing faster closure, reduced pain, lower infection rates, better cosmetic outcomes, and improved cost-effectiveness. These results support the routine adoption of tissue adhesives in surgical practice.

4. DISCUSSION

This study compared N-Butyl Cyanoacrylate (tissue adhesive) with conventional sutures for skin closure in open inguinal hernia repair, evaluating their effectiveness in terms of wound closure time, postoperative pain, wound infection rates, cosmetic outcomes, and cost-effectiveness **[9]**. The findings suggest that N-Butyl Cyanoacrylate offers significant advantages over sutures, making it a superior choice for enhancing operative efficiency, reducing postoperative discomfort, and improving overall patient satisfaction **[10]**.

Comparison with Existing Literature

The significant reduction in wound closure time in the N-Butyl Cyanoacrylate group (4.73 ± 1.57 minutes) compared to the suture group (7.10 ± 1.97 minutes, $p<0.001$) aligns with previous studies that have demonstrated the efficiency of tissue

adhesives in reducing operative duration. Similar findings were reported by Ong et al. (2020) and Tandon et al. (2018), who observed that glue-based closure techniques reduced skin closure time by approximately 30-40% compared to sutures. The rapid polymerization of cyanoacrylate adhesives eliminates the need for needle handling, leading to a faster and more streamlined closure process **[11]**.

Postoperative pain assessment using the Visual Analog Scale (VAS) revealed significantly lower pain scores in the N-Butyl Cyanoacrylate group at 6, 12, and 24 hours postoperatively ($p<0.001$). These findings correlate with studies by Gonzalez et al. (2019), who reported that patients with glue-based closure had reduced pain due to the absence of suture-related skin tension and decreased need for local anesthesia. The reduced mechanical irritation and inflammatory response associated with tissue adhesives may contribute to the improved pain outcomes observed in the glue group **[12]**.

A crucial factor in surgical wound management is the risk of wound infections. The current study found that wound infection rates were lower in the glue group, with a mean ASEPSIS score of 1.97 ± 0.93 compared to 3.16 ± 0.62 in the suture group ($p<0.001$). The ability of N-Butyl Cyanoacrylate to form a microbial barrier may explain its protective effect against bacterial colonization, a concept supported by Bhattacharya et al. (2017), who reported that cyanoacrylate adhesives reduce bacterial penetration and create a waterproof seal, lowering infection risks **[13]**.

Cosmetic and Functional Outcomes

Cosmetic outcomes are a major concern in elective surgical procedures, as poor scar formation can impact patient satisfaction and long-term quality of life. The Vancouver Scar Scale (VSS) assessment at 2 weeks and 1 month showed significantly better cosmetic outcomes in the glue group ($p<0.001$) **[14]**. These results are consistent with Almeida et al. (2021), who demonstrated that glue-based closure techniques result in less hypertrophic scarring and improved scar texture compared to sutures. The absence of suture tracks and reduced inflammatory response with tissue adhesives likely contribute to improved scar healing **[15]**.

Although no major wound dehiscence was reported in either group, minor wound separation was observed in 3.3% of glue patients versus 10% of suture patients, highlighting similar safety profiles between the two methods. Studies by Singh et al. (2020) have shown that wound dehiscence rates with cyanoacrylate adhesives remain low when applied correctly, reinforcing its clinical reliability **[16]**.

Cost-Effectiveness Analysis

Economic considerations are critical when evaluating alternative wound closure techniques. The study's cost analysis revealed that N-Butyl Cyanoacrylate was more cost-effective than sutures, primarily due to reduced operative time and lower need for postoperative wound care. The mean procedural cost in the glue group was INR $18,200 \pm 850$ compared to INR $19,500 \pm 950$ in the suture group ($p=0.002$). Similar findings have been reported by Mohammed et al. (2019), who noted that tissue adhesives, despite their higher initial cost per unit, lead to overall cost savings by reducing dressing requirements and eliminating the need for suture removal visits **[17]**. Furthermore, surgeons in this study significantly preferred N-Butyl Cyanoacrylate over sutures ($p<0.001$), citing its ease of application and improved workflow efficiency. A comparable study by Harish et al. (2022) emphasized that surgeon preference for glue-based closures stems from its speed, reduced risk of needle-stick injuries, and patient compliance advantages **[18]**.

Patient Satisfaction and Follow-up Compliance

The study found that patients in the glue group reported higher satisfaction levels (86.7% vs. 50.0%, $p=0.002$) and required fewer follow-up visits for wound-related issues (6.7% vs. 26.7%, $p=0.04$). This aligns with studies by Navarro et al. (2020), who found that patients preferred glue-based closure due to its non-invasive nature, absence of suture removal discomfort, and superior cosmetic results **[19]**.

Overall, these findings suggest that N-Butyl Cyanoacrylate enhances patient comfort, reduces the need for follow-ups, and improves long-term outcomes, supporting its routine use in elective inguinal hernia repair.

Clinical Implications and Recommendations

Based on these findings, several key recommendations can be made:

1. N-Butyl Cyanoacrylate should be considered a primary option for skin closure in open inguinal hernia repair, given its faster application time and reduced postoperative pain.
2. Tissue adhesives may be particularly beneficial in high-volume surgical settings, where reducing operative time and resource utilization is a priority.
3. The superior cosmetic outcomes associated with N-Butyl Cyanoacrylate make it an ideal choice for elective surgical procedures where aesthetics matter.
4. Cost-effectiveness evaluations favor the use of tissue adhesives, especially in resource-conscious healthcare settings

where long-term follow-up costs should be minimized.

5. Surgeon training in the correct application of N-Butyl Cyanoacrylate should be emphasized, as improper usage can contribute to wound dehiscence and suboptimal closure outcomes.
6. Future research should explore long-term outcomes beyond 3 months, evaluating wound recurrence, hypertrophic scarring, and patient-reported quality-of-life improvements.

Strengths and Limitations of the Study

A major strength of this study is its randomized controlled design, allowing for objective comparisons between N-Butyl Cyanoacrylate and sutures. The blinded postoperative assessments further minimized observer bias, enhancing the study's internal validity. Additionally, the study incorporated multiple outcome measures, including pain, infection rates, scar formation, cost-effectiveness, and surgeon preference, ensuring a comprehensive evaluation of closure techniques **[20]**.

However, several limitations must be acknowledged. The sample size (n=60) was relatively small, which may limit the generalizability of the findings. Additionally, the follow-up period was limited to 1 month, preventing an assessment of long-term scar remodeling and recurrence risks **[21]**. Finally, the study was conducted in a single tertiary care center, which may limit the applicability of findings to different healthcare settings with variable resource availability. Future multicenter trials with larger sample sizes and extended follow-up periods are recommended to further validate these findings and establish standardized guidelines for skin closure techniques in open inguinal hernia repair **[22]**.

This study provides compelling evidence that N-Butyl Cyanoacrylate is a superior alternative to sutures for skin closure in open inguinal hernia repair, offering significant advantages in terms of operative efficiency, reduced pain, lower infection rates, improved cosmetic outcomes, and greater cost-effectiveness. Given these benefits, tissue adhesives should be integrated into routine surgical practice as a preferred wound closure method.

5. CONCLUSION

This randomized controlled study compared N-Butyl Cyanoacrylate (tissue adhesive) with conventional sutures for skin closure in open inguinal hernia repair, assessing their effectiveness in terms of operative efficiency, postoperative pain, wound infection rates, cosmetic outcomes, and cost-effectiveness. The findings demonstrate that N-Butyl Cyanoacrylate is a superior alternative to sutures, offering shorter wound closure time, reduced postoperative pain, lower infection rates, improved cosmetic appearance, and greater cost-effectiveness.

The mean wound closure time was significantly lower in the glue group (4.73 ± 1.57 minutes) compared to the suture group (7.10 ± 1.97 minutes, $p<0.001$), highlighting its advantage in surgical efficiency. Patients in the glue group reported significantly lower pain scores at 6, 12, and 24 hours postoperatively ($p<0.001$), indicating reduced tissue trauma and inflammation. The mean ASEPSIS score for wound infection was significantly lower in the glue group (1.97 ± 0.93) compared to the suture group (3.16 ± 0.62, $p<0.001$), reinforcing the antimicrobial barrier properties of N-Butyl Cyanoacrylate. Furthermore, cosmetic outcomes assessed using the Vancouver Scar Scale (VSS) were superior in the glue group ($p<0.001$), suggesting that tissue adhesives promote aesthetically favorable scar formation.

The cost-effectiveness analysis revealed that N-Butyl Cyanoacrylate was more economical than sutures ($p=0.002$), primarily due to shorter operative time, reduced postoperative dressing requirements, and elimination of suture removal visits. Additionally, surgeons strongly preferred tissue adhesive closure over sutures ($p<0.001$), citing its ease of application and time-saving benefits. Patient satisfaction scores were also significantly higher in the glue group ($p=0.002$), with fewer follow-up visits required for wound-related concerns ($p=0.04$).

Future Directions and Recommendations

While this study provides compelling evidence supporting the routine use of N-Butyl Cyanoacrylate for skin closure in open inguinal hernia repair, further research is required to assess its long-term effects, including hypertrophic scar formation, recurrence rates, and patient-reported quality-of-life outcomes. Future studies should focus on:

1. Evaluating long-term outcomes beyond 3 months, particularly in terms of scar remodeling and recurrence risks.
2. Conducting multicenter trials with larger sample sizes to enhance the generalizability of findings.
3. Comparing tissue adhesives with advanced suture techniques, such as barbed sutures or absorbable subcuticular sutures, to establish comprehensive guidelines for optimal wound closure methods.
4. Assessing cost-effectiveness in different healthcare settings, including low-resource hospitals where economic feasibility plays a crucial role in decision-making.
5. Developing standardized training programs for surgeons on the correct application of tissue adhesives to minimize the risk of improper usage and wound dehiscence.

Final Summary

This study provides compelling evidence that N-Butyl Cyanoacrylate is a safer, faster, and more cost-effective alternative to sutures for skin closure in open inguinal hernia repair. Given its advantages in reducing pain, improving cosmesis, and enhancing overall patient satisfaction, tissue adhesives should be considered a preferred method for wound closure in elective surgical procedures. Future studies should focus on expanding the scope of tissue adhesives in surgical wound management, ensuring their broader adoption in clinical practice.

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