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Comparison of sutureless and sutured circumcision in pediatric populations: A systematic review

Muhammad Ikhsan Farhan[1]*, Jufriady Ismy[2], Ahmad Fauzan[2,3], Vannisa Fadya[1]

[1]Program Studi Pendidikan Dokter, Fakultas Kedokteran, Universitas Syiah Kuala
[2]Program Studi Urologi, Fakultas Kedokteran, Universitas Syiah Kuala/ Rumah Sakit Umum Dr. Zainoel Abidin
[3]Fakultas Kedokteran, Universitas Malikussaleh
Corresponding author: *E-mail: ikhsanfarhan01@gmail.com

Abstract

Background: Circumcision is one of the most commonly performed pediatric surgical procedures and is traditionally closed using absorbable sutures. However, conventional suturing may increase postoperative pain, edema, infection risk, foreign-body reactions, and cosmetic irregularities. Sutureless techniques, including cyanoacrylate-based tissue adhesives and clamp-assisted methods, have emerged as minimally invasive alternatives that may improve wound healing and reduce complications.
Purpose: To systematically compare the safety, procedural efficiency, cosmetic outcomes, and postoperative pain associated with sutureless versus conventional sutured circumcision in pediatric populations.
Method: This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A comprehensive literature search was performed using PubMed, Wiley, and Google Scholar databases. Study quality and risk of bias were evaluated using the Revised Tool for Risk of Bias in Randomized Trials (ROB 2). Three eligible comparative studies were included in the final analysis.
Results: Sutureless circumcision demonstrated several advantages over conventional sutured techniques, including shorter operative time, fewer postoperative complications, and superior cosmetic outcomes. Most suture-related adverse events, such as local irritation and foreign-body reactions, were reported exclusively in the sutured groups. In addition, patients undergoing sutureless procedures generally experienced lower postoperative pain scores.
Conclusion: Sutureless circumcision using cyanoacrylate adhesives appears to be a safe and effective alternative to traditional sutured closure, offering improved procedural efficiency and postoperative outcomes. Nevertheless, the current evidence is limited by small sample sizes, heterogeneous study populations, and non-standardized outcome measures. Further large-scale, well-designed comparative studies are needed to establish robust clinical recommendations.

Keywords: Circumcision; Cyanoacrylate Adhesive; Pediatric.

INTRODUCTION

Circumcision is one of the most widely performed pediatric surgical procedures globally, undertaken for cultural, religious, and clinical reasons such as phimosis, recurrent balanoposthitis, urinary tract infections, and inflammatory penile disorders including balanitis xerotica obliterans (Dhaliwal, Dor, George, & Wei, 2025; Raut, 2019) Traditional circumcision methods typically rely on interrupted absorbable sutures, providing effective hemostasis and stable tissue approximation (Raut, 2019). However, sutures may lengthen operative duration and cause postoperative discomfort due to needle puncture trauma and localized inflammatory reactions (Pervez, Narmeen, Halder, Shahnaz, & Salehin, 2025; Raut, 2019). The use of sutures may also lead to foreign-body granulomas and

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occasionally leave visible skin markings, contributing to cosmetic dissatisfaction among parents (Bar-Yaakov, Mano, Ekstein, Savin, Dekalo, Ben-Chaim, & Bar-Yosef, 2022; Raut, 2019).

In recent years, there has been growing interest in minimally invasive wound-closure methods for pediatric surgery, including sutureless circumcision techniques (Spinelli, Bertocchini, Leoni, Calani, Morganti, & Strambi, 2020). Cyanoacrylate-based tissue adhesives — such as isoamyl 2-cyanoacrylate and n-butyl-cyanoacrylate — rapidly polymerize upon contact with tissue fluid to create a protective epidermal barrier with minimal manipulation of tissue edges (Azmi, Yogiswara, & Renaldo, 2022; Spinelli et al., 2020). These adhesives also possess bacteriostatic properties that may reduce early postoperative infections, supported by laboratory evidence demonstrating antimicrobial barrier function in cyanoacrylate-derived wound films (Rushbrook, White, Kidger, Marsh, & Taggart, 2014; Singer, Quinn, Clark, Hollander, & Group, 2002).

Clinically, the use of tissue adhesives has been associated with decreased operative time, reduced postoperative edema, and improved wound cosmesis compared with conventional suturing (Raut, 2019; Spinelli et al., 2020). Because adhesives harden without the need for suture removal, parental anxiety and postoperative handling of the surgical site may be further minimized (Najar, Nabi, Mufti, Baba, & Bhat, 2025).

Sutureless approaches also include mechanical clamp-based techniques, which are widely used in neonatal circumcision (Bawazir & Banaja, 2020). Mechanical clamps provide rapid hemostasis without needle punctures, thereby reducing tissue handling and minimizing wound trauma (Soomro, Arain, Abbas, Qudratullah, Bukhari, & Ahmed, 2025). Evidence suggests that eliminating sutures in neonatal circumcision can reduce complications such as stitch sinus, granuloma formation, and epidermoid cysts related to retained suture tracts (Bawazir & Banaja, 2020; Lovin, Stone, Pickett, & Kirsch, 2022). Furthermore, neonatal clamp procedures performed without sutures consistently demonstrate shorter operative durations compared with sutured methods (Bawazir & Banaja, 2020).

Despite promising results, the literature comparing sutureless and sutured circumcision remains heterogeneous, with variations in age groups, surgical techniques, wound-care protocols, and outcome measurement tool (Bawazir & Banaja, 2020; Raut, 2019; Spinelli et al., 2020) Complications such as edema, infection, pain, or wound dehiscence are assessed inconsistently, and aesthetic evaluations range from subjective parental grading to structured visual analog scoring (Spinelli et al., 2020) Differences in study design — ranging from observational cohorts to randomized clinical trials — further complicate comparative interpretation (Lovin et al., 2022).

These inconsistencies highlight the need for a systematic synthesis of evidence to determine the clinical value of sutureless circumcision techniques. By examining outcomes including bleeding, infection, edema, wound integrity, operative time, cosmetic results, and postoperative pain, this review seeks to clarify whether sutureless circumcision methods offer a superior alternative to traditional sutured techniques in clinical practice.

RESEARCH METHOD

This study was conducted as a systematic review comparing sutureless and conventional sutured circumcision techniques in pediatric populations. The review followed the methodological principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, including predefined eligibility criteria, structured data extraction, and transparent reporting of study selection.

Studies were included if they: (1) involved male neonates, infants, children, or adolescents (0–18 years) undergoing circumcision, (2) used a sutureless method for wound closure, such as cyanoacrylate adhesive or clamp-based techniques without sutures, (3) included a comparison group that received conventional circumcision with sutures, (4) reported at least one clinical outcome related to complications, operative time, cosmetic appearance, or postoperative pain, (5) used a comparative study design, either randomized or observational, (6) were available as full-text articles in English. Studies were excluded if they: (1) studies that did not evaluate a defined wound-closure technique, (2) studies in which sutureless and sutured groups could not be clearly distinguished, and (3) studies reporting mixed adult–pediatric data without separable pediatric outcomes.

Muhammad Ikhsan Farhan[1]*, Jufriady Ismy[2], Ahmad Fauzan[2,3], Vannisa Fadya[1]

[1]Program Studi Pendidikan Dokter, Fakultas Kedokteran, Universitas Syiah Kuala
[2]Program Studi Urologi, Fakultas Kedokteran, Universitas Syiah Kuala/ Rumah Sakit Umum Dr. Zainoel Abidin
[3]Fakultas Kedokteran, Universitas Malikussaleh
Corresponding author: *E-mail: ikhsanfarhan01@gmail.com

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The authors systematically conducted a search across three electronic databases— PubMed, Wiley, and Google Scholar—to identify comparative studies evaluating sutureless versus sutured circumcision in pediatric populations. The search was performed from database inception with no publication year restrictions. Both MeSH terms and free-text keywords were used, applying Boolean operators (AND, OR), phrase searching, and truncation. Reference lists of included studies were also reviewed to capture additional eligible articles. The keywords applied were:

PubMed: ((“Circumcision”[Mesh] OR circumcision* OR “pediatric circumcision” OR “paediatric circumcision” OR “neonatal circumcision”) AND (sutureless OR “Tissue Adhesives”[Mesh] OR “tissue adhesive*” OR cyanoacrylate OR “skin glue”) AND (suture* OR “absorbable suture*” OR sutured OR “sutured closure”)) AND (“Infant”[Mesh] OR “Child”[Mesh] OR pediatric* OR paediatric* OR neonatal*).

Wiley Online Library: (circumcision* OR “pediatric circumcision” OR “paediatric circumcision” OR “neonatal circumcision”) AND (sutureless OR “tissue adhesive*” OR cyanoacrylate OR “skin glue”) AND (suture* OR “absorbable suture*” OR sutured OR “sutured closure”) AND (pediatric* OR paediatric* OR neonatal* OR child*).

Google Scholar: “circumcision” AND (“sutureless” OR “tissue adhesive” OR cyanoacrylate) AND (“sutured” OR “sutured closure”) AND (pediatric OR paediatric OR neonatal OR child).

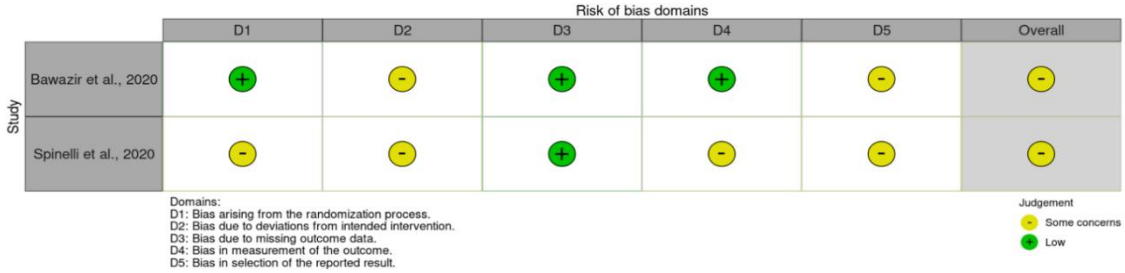
After running the search, all retrieved records from the three databases were combined and screened for duplicates using title, year of publication, and DOI. Two reviewers independently screened the studies, with disagreements resolved through discussion. The selection process involved an initial screening of titles and abstracts to remove irrelevant studies, followed by full-text assessment based on predefined inclusion and exclusion criteria. Through this process, three comparative studies were identified as eligible for inclusion in the review: Raut (2019), Spinelli et al. (2020), and Bawazir & Banaja (2020). The overall selection process is illustrated in the PRISMA flow diagram, and all references were organized using Mendeley reference manager.

Data extraction was performed using a structured data-extraction form developed specifically for this review. For each eligible study, the reviewers collected detailed information including the author’s name, year of publication, country of origin, study design, sample size, patient age distribution, and indications for circumcision. The form also captured comprehensive descriptions of the sutureless techniques used, such as the type of cyanoacrylate adhesive or the specific clamp device applied, as well as the characteristics of the sutured comparator, including suture material and closure method.

Extracted outcome variables encompassed safety parameters (bleeding, infection, edema, wound gaping or dehiscence, and granuloma or sinus formation), measures of procedural efficiency such as operative time and ease of closure, aesthetic results based on cosmetic scoring tools or parental satisfaction, and postoperative pain outcomes including pain scores and analgesic requirements. All data were extracted independently by two reviewers, and any discrepancies were resolved through discussion to ensure accuracy and consistency. Detailed of data extracted are shown in the Appendix 2.

Risk of bias was evaluated according to the methodological design of each included study. Randomized controlled trials, such as those by Spinelli and by Bawazir, were appraised by ROB 2 tool. The non-randomized comparative study by Raut was assessed for risks using ROBINS-I tool. The results of risk of bias are explained in Table 1 and 2.

Table 1. Risk of Bias of RCT studies using ROB 2 tool

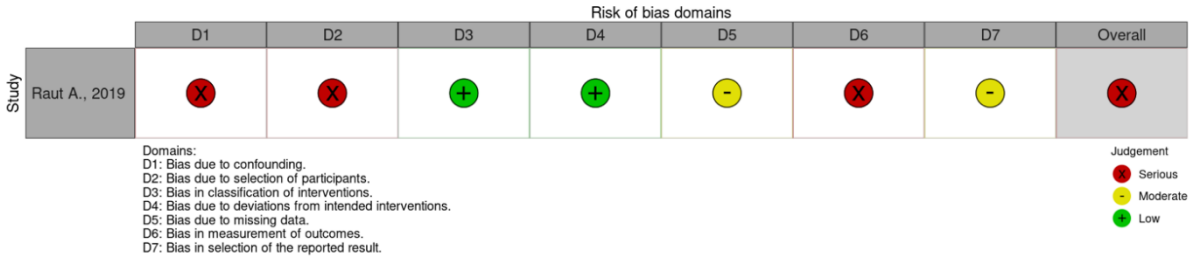


Muhammad Ikhsan Farhan[1]*, Jufriady Ismy[2], Ahmad Fauzan[2,3], Vannisa Fadya[1]

[1]Program Studi Pendidikan Dokter, Fakultas Kedokteran, Universitas Syiah Kuala
[2]Program Studi Urologi, Fakultas Kedokteran, Universitas Syiah Kuala/ Rumah Sakit Umum Dr. Zainoel Abidin
[3]Fakultas Kedokteran, Universitas Malikussaleh
Corresponding author: *E-mail: ikhsanfarhan01@gmail.com

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Table 2. Risk of Bias of non RCT study using ROBINS-I too



RESEARCH RESULTS

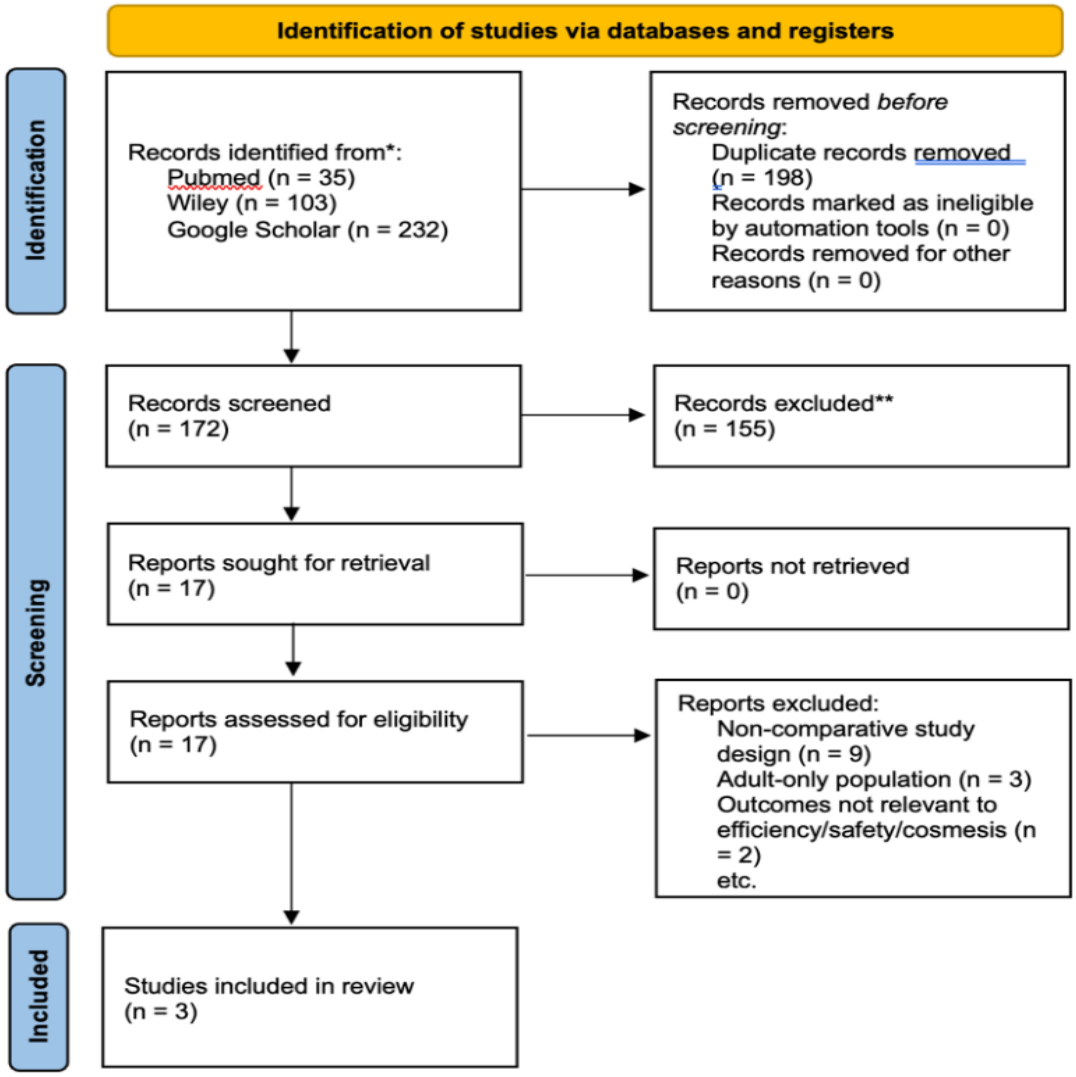


Figure 1. PRISMA 2020 Flow Diagram of Study Selecti

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[1]Program Studi Pendidikan Dokter, Fakultas Kedokteran, Universitas Syiah Kuala
[2]Program Studi Urologi, Fakultas Kedokteran, Universitas Syiah Kuala/ Rumah Sakit Umum Dr. Zainoel Abidin
[3]Fakultas Kedokteran, Universitas Malikussaleh
Corresponding author: *E-mail: ikhsanfarhan01@gmail.com

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Table 3. Characteristics of the Included Studies

(Author, Year) (Country)	Study Design	Population/ Indication	Sample Size; Age	Intervention	Comparison	Surgical Technique	Follow-up	Operative Time	Postoperative Pain	Complications	Cosmetic Outcome	Cost Analysis
(Raut, 2019) (India)	Prospective comparative study	Pediatric patients with phimosis; balanoposthitis; recurrent balanoposthitis; BXO; recurrent UTI	324 (162 glue; 162 sutured) 1.5–14 years	Isoamyl cyanoacrylate tissue adhesive	Interrupted absorbable sutures (4-0/5-0)	Sleeve technique	24 h; day 4; day 7; 1 month; 3 months	NR	Lower pain and analgesic requirement in glue group	Swelling: 0 vs 7; Bleeding: 0 vs 1; Infection: 0 vs 3; Dehiscence: 1 vs 0; Foreign body reaction: 2 vs 3	Superior cosmesis and wound healing in glue group	NR
(Spinelli et al., 2020) (Italy)	Prospective randomized study	Pediatric circumcision for religious/ethical reasons or phimosis	160 (80 glue; 80 suture) 18 - 168 Months	NBCA-MS glue (Glubran2)	Interrupted 5-0 polyglycolic acid sutures	Cold-scalpel circumcision	Day 7; day 30; day 180	14 ± 1.3 min vs 20 ± 1.5 min (P<0.001)	No significant difference	Edema: 0% vs 25%; Infection: 0% vs 7.5%; Bleeding: 0 vs 0; Dehiscence: 0 vs 0	Significantly better cosmetic results (P<0.001)	Glue cheaper ($27 vs $49.50)
(Bawazir & Banaja, 2020) (Saudi Arabia)	Randomized controlled clinical trial	Neonatal circumcision for social; cultural; personal; and religious reasons	182 (94 sutureless; 88 sutured) Neonates <4 weeks	Sutureless closure after Gomco clamp removal	Interrupted 6/0 absorbable polyglactin (Vicryl) sutures	Gomco clamp circumcision	Day 7; 1 month; 6 months; 24 months	6.54 ± 1.42 min vs 12.24 ± 2.17 min (P<0.001)	NR	Bleeding: 4.26% vs 2.27%; Wound gaping: 8.5% vs 1.14%; Skin sinus: 0% vs 15.91%; Cyst: 2.13% vs 14.77%	Better long-term cosmetic outcome due to lower sinus and cyst formation	NR

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[1]Program Studi Pendidikan Dokter, Fakultas Kedokteran, Universitas Syiah Kuala
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[3]Fakultas Kedokteran, Universitas Malikussaleh
Corresponding author: *E-mail: ikhsanfarhan01@gmail.com

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Safety Outcomes

Bleeding

Across all studies, postoperative bleeding was infrequent and generally comparable between sutureless and sutured groups. No bleeding events were reported in the adhesive group and only a single minor event in the sutured group (Raut, 2019), and no bleeding episodes were documented in either arm (Spinelli et al., 2020). In contrast, minor bleeding was observed in both techniques, with slightly more events in the sutureless group (four vs. two cases), although none were clinically significant (Bawazir & Banaja, 2020). Collectively, these findings indicate that sutureless closure does not increase bleeding risk and is at least as safe as conventional suturing in this regard.

Infection

A more pronounced advantage emerged in infection outcomes. Lower postoperative infection rates were reported with cyanoacrylate adhesives (Raut, 2019; Spinelli et al., 2020), with zero infections in the sutureless group were documented compared to three in the sutured group (Raut, 2019), and six infections were reported exclusively in the sutured arm (Spinelli et al., 2020). (Bawazir & Banaja, 2020) found no infections in either group. Overall, sutureless closure—particularly adhesive-based techniques—appears to reduce infection risk, likely due to the bacteriostatic properties of cyanoacrylate and reduced manipulation of the wound.

Edema and swelling

All included studies demonstrated reduced postoperative edema with sutureless methods. No edema in the adhesive group was observed compared to seven cases in the sutured cohort (Raut, 2019). An even more substantial difference, with zero cases of swelling in the adhesive group versus twenty in the sutured group was reported (Spinelli et al., 2020). Mild swelling was noted in both groups, though it was not clinically significant (Bawazir & Banaja, 2020). These findings suggest that sutureless techniques minimize tissue trauma and subsequent inflammation more effectively than sutures.

Wound dehiscence/ gaping

Findings on wound dehiscence varied according to the type of sutureless technique used. Cyanoacrylate-based closure showed an extremely low risk of gaping, with one case was reported (Raut, 2019) and none was reported (Spinelli et al., 2020). However, clamp-only techniques—as examined in the neonatal population were associated with a markedly higher dehiscence rate, with eight cases in the sutureless group compared to one in the sutured group (Bawazir & Banaja, 2020). This disparity highlights that not all sutureless methods function similarly; adhesive-based closure provides stronger wound approximation than clamp-only techniques.

Complications

Long-term outcomes further emphasized the risks associated with sutures. The sutured group demonstrated significantly higher rates of late complications, including 27 cases of cyst or sinus formation compared with only two in the sutureless group (Bawazir & Banaja, 2020). These chronic issues are believed to arise from foreign-body reactions and epithelial inclusion associated with suture materials. In contrast, sutureless neonatal circumcision avoids suture retention entirely, thereby reducing the risk of such persistent complications.

Efficiency Outcomes

Operative time

Both randomized trials consistently demonstrated that sutureless circumcision required substantially less operative time. Adhesive closure was reported to reduce operative duration by approximately six minutes (14 vs. 20 minutes) (Spinelli et al., 2020), and a reduction was also reported in neonates (6.5 vs. 12.2 minutes) (Bawazir & Banaja, 2020). Although precise timing was not provided (Raut, 2019), the author noted that adhesive-based procedures were “faster and simpler.” Overall, sutureless methods shortened surgery by 25–50%, improving surgical efficiency and reducing the duration of physiological stress for young children and infants.

Cost efficiency

Cost analysis was reported only in one study, which found that cyanoacrylate adhesive was less expensive than sutures (USD 27 vs. USD 49.5 per case) (Spinelli et al., 2020). When combined with shorter operative times, sutureless methods demonstrated a clear economic benefit, although more economic data would strengthen this conclusion.

Muhammad Ikhsan Farhan[1]*, Jufriady Ismy[2], Ahmad Fauzan[2,3], Vannisa Fadya[1]

[1]Program Studi Pendidikan Dokter, Fakultas Kedokteran, Universitas Syiah Kuala
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[3]Fakultas Kedokteran, Universitas Malikussaleh
Corresponding author: *E-mail: ikhsanfarhan01@gmail.com

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Cosmetic Outcomes

All three studies agreed that sutureless circumcision produced superior cosmetic results. Smoother wound edges were observed, the absence of suture marks, and higher parental satisfaction (Raut, 2019). Better scar quality and overall aesthetic appearance were confirmed in the adhesive group (Spinelli et al., 2020). Even in the clamp-based neonatal approach, fewer suture-related distortions were reported, although this technique still carried a higher risk of early gaping (Bawazir & Banaja, 2020). Overall, cyanoacrylate adhesives consistently yielded more uniform wound borders and better cosmetic outcomes, making esthetics one of the strongest advantages of sutureless closure.

Pain Outcomes

Pain outcomes, although not evaluated in every study, consistently favored sutureless techniques when measured. Lower VAS scores at both 6 and 12 hours postoperatively in the adhesive group were reported (Raut, 2019), and significantly lower ChIPPS pain scores were documented at all measured time points (4, 8, and 24 hours) (Spinelli et al., 2020). These differences likely reflect the reduced tissue penetration and elimination of suture tension associated with adhesive closure. However, pain was not assessed (Bawazir & Banaja, 2020), limiting comparisons among neonates.

Taken together, the three studies demonstrate that sutureless circumcision — particularly when using cyanoacrylate tissue adhesives — provides several clinical benefits over conventional suturing. These include superior cosmetic outcomes, reduced postoperative pain, shorter operative times, and lower or comparable rates of complications. Furthermore, long-term suture-related problems such as sinus tracts and inclusion cysts were markedly more common among children who underwent sutured closure. Although clamp-only methods yielded mixed safety results due to higher rates of wound gaping, they still offered advantages in reducing chronic complications. Overall, adhesive-based sutureless circumcision can be considered a safe, efficient, and cosmetically favorable alternative to traditional suturing in pediatric surgical practice.

DISCUSSION

The present systematic review compared sutureless and conventional sutured circumcision techniques in pediatric and neonatal populations using evidence drawn from three clinical studies and supported by foundational literature from their original references. Overall, the findings consistently indicate that sutureless methods — particularly those employing cyanoacrylate adhesives — offer several clinical advantages, including reduced infection rates, shorter operative times, improved cosmetic outcomes, and lower incidence of long-term suture-related complication (Bawazir & Banaja, 2020; Raut, 2019; Spinelli et al., 2020). These findings align with earlier evidence demonstrating that suture materials may provoke foreign-body reactions, stitch sinuses, and epidermoid cyst formation in neonatal circumcision (Azoz, Osman, Idris, Musa, Alhasan, Baloul, & Bakhiet, 2025).

One of the clearest benefits observed across the studies is the reduced infection profile associated with tissue adhesives. Cyanoacrylates possess intrinsic bacteriostatic activity, which has been documented in experimental and clinical settings. This antimicrobial property likely contributes to the lower infection rates observed in the sutureless groups of both pediatric trials. Additionally, faster wound sealing reduces the exposure of raw tissue to contaminants, which may further minimize postoperative infection risk (Aravind, Sunil, Chandrasekar, Shidlingappa, Kamat, Kulkarni, & Vaidyanathan, 2024). Operative efficiency also consistently favored sutureless methods. Both randomized trials demonstrated that eliminating suturing significantly shortened the duration of surgery, a finding consistent with earlier reports suggesting that adhesives can streamline surgical workflow by reducing technical steps and operative manipulation (Dhaliwal et al., 2025). Shorter operative time is particularly advantageous in neonates, where minimizing procedural duration can reduce physiological stress and the need for prolonged immobilization.

Cosmetic outcomes were uniformly superior in the groups treated with cyanoacrylate. Traditional suturing may leave track marks, uneven wound edges, and potential scar hypertrophy — issues that

Muhammad Ikhsan Farhan[1]*, Jufriady Ismy[2], Ahmad Fauzan[2,3], Vannisa Fadya[1]

[1]Program Studi Pendidikan Dokter, Fakultas Kedokteran, Universitas Syiah Kuala
[2]Program Studi Urologi, Fakultas Kedokteran, Universitas Syiah Kuala/ Rumah Sakit Umum Dr. Zainoel Abidin
[3]Fakultas Kedokteran, Universitas Malikussaleh
Corresponding author: *E-mail: ikhsanfarhan01@gmail.com

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have been recognized in pediatric surgical literature (Tandon, Ensor, Pacilli, Laird, Bortagaray, Stunden, & Nataraja, 2022). By contrast, tissue adhesives bond epidermal surfaces smoothly without needle punctures, producing cleaner cosmetic results. This is especially relevant in genital surgery, where appearance strongly influences parental satisfaction and long-term psychological impact.

Nevertheless, results from neonatal clamp-based sutureless circumcision require careful interpretation. In Bawazir's study, wound gaping was significantly more frequent in the sutureless group, a finding likely attributable to the absence of adhesive support and the reliance solely on mechanical hemostasis. Clamp-based techniques differ fundamentally from adhesive-based closure in tensile strength, wound approximation, and post-procedural stability, as previously highlighted in comparative surgical studies (Azmi et al., 2022). This explains the divergence in dehiscence outcomes and underscores that "sutureless" is not a uniform category—adhesive and clamp-only methods function differently and yield different complication profiles.

Importantly, when considering long-term outcomes, the neonatal sutured group demonstrated markedly higher rates of sinus and cyst formation—a pattern consistent with historical observations showing that retained or slowly absorbable sutures can trigger epithelial inclusion and tract formation (Yu, Tang, & Ding, 2022). Unlike sutures that remain within the dermis during the healing process, cyanoacrylate adhesives polymerize on the skin surface and naturally slough off, thereby avoiding retained foreign-body material (Singer, Quinn, & Hollander, 2008). Evidence from a systematic analyses also supports these findings. A meta-analysis evaluating the use of tissue glue in pediatric circumcision reported that adhesive closure was associated with reduced postoperative pain, shorter operative time, and improved cosmetic outcomes compared with sutured closure, while maintaining similar overall complication rates. The study also noted lower rates of postoperative bleeding and hematoma formation in the tissue adhesive group (Martin, Nataraja, Kimber, & Pacilli, 2018).

In addition, minimally invasive circumcision techniques utilizing cyanoacrylate adhesives and specialized devices have been shown to provide rapid wound closure and excellent cosmetic results with minimal adverse events. Clinical trials evaluating adhesive-based circumcision approaches reported operative times as short as 10 minutes with complete wound healing within four weeks, demonstrating the procedural efficiency and safety of sutureless methods (Millard & Goldstuck, 2020)

However, not all outcomes uniformly favor adhesive application. Some randomized studies have shown that while cyanoacrylate adhesives provide satisfactory cosmetic outcomes and wound closure, they may not significantly reduce certain postoperative complications such as penile adhesions when compared with conventional management strategies. These findings highlight the need for careful patient selection and standardized outcome reporting in circumcision research (Alemayehu, Sharp, Gonzalez, Poola, Snyder, & Peter, 2017).

Although the evidence strongly supports sutureless methods, the heterogeneity across studies—differences in patient age, circumcision technique, adhesive formulation, and outcome measurement—limits universal generalization. Additionally, cosmetic and pain assessments varied significantly across studies, reflecting subjective elements that complicate cross-study comparison. These limitations mirror broader challenges identified in circumcision research, where outcome definitions and follow-up durations differ widely (Dhaliwal et al., 2025) Despite these methodological variations, the collective evidence suggests that sutureless circumcision—especially when cyanoacrylates are used—may provide a safer, more efficient, and aesthetically superior alternative to conventional suturing in most pediatric contexts.

CONCLUSION

Sutureless circumcision techniques demonstrate clear clinical advantages over conventional sutured closure in pediatric and neonatal populations, particularly when cyanoacrylate tissue adhesives are utilized. Across the included studies, sutureless methods showed shorter operative times, lower infection rates, improved cosmetic outcomes, reduced postoperative pain, and fewer long-term complications such as sinus and cyst formation.

Muhammad Ikhsan Farhan[1]*, Jufriady Ismy[2], Ahmad Fauzan[2,3], Vannisa Fadya[1]

[1]Program Studi Pendidikan Dokter, Fakultas Kedokteran, Universitas Syiah Kuala
[2]Program Studi Urologi, Fakultas Kedokteran, Universitas Syiah Kuala/ Rumah Sakit Umum Dr. Zainoel Abidin
[3]Fakultas Kedokteran, Universitas Malikussaleh
Corresponding author: *E-mail: ikhsanfarhan01@gmail.com

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However, clamp-only sutureless approaches may increase the risk of wound gaping and require careful technique-specific consideration. Overall, current evidence supports the incorporation of sutureless closure—especially adhesive-based methods—as a preferable approach in routine pediatric circumcision practice. Further high-quality randomized trials with standardized outcome measures are needed to clarify technique-specific risks and to establish uniform clinical guidelines.

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Muhammad Ikhsan Farhan[1]*, Jufriady Ismy[2], Ahmad Fauzan[2,3], Vannisa Fadya[1]

[1]Program Studi Pendidikan Dokter, Fakultas Kedokteran, Universitas Syiah Kuala
[2]Program Studi Urologi, Fakultas Kedokteran, Universitas Syiah Kuala/ Rumah Sakit Umum Dr. Zainoel Abidin
[3]Fakultas Kedokteran, Universitas Malikussaleh
Corresponding author: *E-mail: ikhsanfarhan01@gmail.com

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Muhammad Ikhsan Farhan[1]*, Jufriady Ismy[2], Ahmad Fauzan[2,3], Vannisa Fadya[1]

[1]Program Studi Pendidikan Dokter, Fakultas Kedokteran, Universitas Syiah Kuala
[2]Program Studi Urologi, Fakultas Kedokteran, Universitas Syiah Kuala/ Rumah Sakit Umum Dr. Zainoel Abidin
[3]Fakultas Kedokteran, Universitas Malikussaleh
Corresponding author: *E-mail: ikhsanfarhan01@gmail.com

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