

Skin wound closure outcome using tissue adhesive versus subcuticular absorbable suture at elective caesarean section in dark-skinned women: A randomized controlled trial

Joshua Ebuka Ifebude

joshua.ebuka@uch-ibadan.org.ng

University College Hospital

Olayinka Ogunbode

University College Hospital

Olutosin Alaba Awolude

University College Hospital

Olukayode Iyun

University of Ibadan

Aminat Oladosu-Aderolu

Federal Medical Centre

Research Article

Keywords: 2-Octyl cyanoacrylate, Caesarean section, Cyanoacrylate, Dermabond, Subcuticular suture, Tissue adhesive, Tissue glue, Vicryl

Posted Date: November 27th, 2025

DOI: <https://doi.org/10.21203/rs.3.rs-7878580/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Skin wound closure outcome using tissue adhesive versus subcuticular absorbable suture at elective caesarean section in dark-skinned women: A randomized controlled trial.

AUTHORS: Joshua Ebuka Ifebude ^a, Olayinka Ogunbode^{a,b}, Olutosin Alaba Awolude^{a,b}, Olukayode Iyunc, Aminat Oladosu-Aderolu^d.

AFFILIATION:

^a*Department of Obstetrics and Gynaecology, University College Hospital, Ibadan, Oyo State, Nigeria*

^b*Department of Obstetrics and Gynaecology, University of Ibadan, Oyo State, Nigeria*

^c*Department of Plastic, reconstructive and aesthetic surgery, University of Ibadan, Oyo State, Nigeria*

^d*Department of Obstetrics and Gynaecology, Federal Medical Centre, Abeokuta, Ogun State, Nigeria*

Corresponding Author: Joshua Ebuka Ifebude

Department of Obstetrics and Gynecology, University College Hospital, Ibadan,

Nigeria, PMB: 5116. Phone number: +2348160882757

E-mail – joshua.ebuka@uch-ibadan.org.ng

ABSTRACT

Background

Skin wound closure is an integral step of caesarean section. Various skin wound closure techniques have been used. However, there is no definite evidence regarding the ideal method for skin closure during Caesarean section. This study, therefore, aimed to compare the use of tissue adhesives with subcuticular absorbable sutures for skin wound closure and to determine patient satisfaction and cosmetic outcomes with each technique.

Methods

This was a two-arm single-blinded superiority randomized controlled trial. Women who had undergone elective cesarean section and met the inclusion criteria were recruited from the antenatal clinic of the University College Hospital, Ibadan. The participants were randomized into either skin closure with Dermabond tissue adhesive (intervention) or Vicryl 2/0 sutures (control). A total of 192 participants were randomized in the study, with 96 participants in each arm.

Results

A total of 185 participants completed the study (Control-92, intervention-93) and were included in the analysis. The mean age of the participants was 32.4 (SD±5.37) years. Approximately 88.9% of the participants had above the primary level of education, mostly Yoruba, by tribe. The patients' assessment of the cosmetic outcome of their surgical wound was significantly better for tissue adhesives ($p=0.008$), whereas there was no difference when it was assessed by the plastic surgeon ($p=0.50$) via the findings from the POSAS.

45 Additionally, there was no significant difference in patient satisfaction with their scar
46 following each closure technique ($p=0.27$). The additional analgesia requirement in the first 24
47 hours after surgery ($p<0.001$) and the duration of skin wound closure ($3.32 \text{ min} \pm 2.27$ for tissue
48 adhesives; $6.52 \text{ min} \pm 2.97$ for sutures; $p<0.01$) were significantly lower in the tissue adhesive
49 group. There was no significant difference in the rate of wound complications between the
50 groups.

51 **Conclusion**

52 The cosmetic outcome and patient satisfaction with tissue adhesive are not superior to those
53 with the use of subcuticular sutures. However, pain control and the speed of skin wound
54 closure were significantly better with tissue adhesives.

56 **Trial Registration**

57 Trial registration was performed online via the Pan African Clinical Trials registry at
58 <https://pactr.samrc.ac.za> and was retrospectively registered with the registration number
59 PACTR202308768448394. Registered on 14th August 2023. Details of the study data and
60 protocol can be accessed from the corresponding author.

62 **Keywords:** “2-Octyl cyanoacrylate”, “Caesarean section”, “Cyanoacrylate”, “Dermabond”,
63 “Subcuticular suture”, “Tissue adhesive”, “Tissue glue”, “Vicryl

64 **BACKGROUND**

Wound closure has remained an important aspect of surgery. This is because the restoration of tissue integrity is highly important in the process of wound healing.¹ Wound healing by primary intention occurs following the approximation of wound edges with sutures, staples, and other mechanical devices, including adhesive tapes and tissue adhesives.² These wound closure techniques differ in their methods of application, removal, degree of inflammatory reaction, infection rate, mechanical properties, and cosmetic results.^{2,3}

Surgical sutures have traditionally been described as products that are made with natural or synthetic, absorbable or nonabsorbable strands, purified ribbons of animal intestines, silk filaments, textiles, and steel. Ideally, they should be inert, nonantigenic, nonpyrogenic, and nontoxic to be useful for joining the ends of a wound and favouring its healing.^{2,4} Polyglactic acid (Vicryl) is currently widely used as an absorbable suture material. It is a synthetic, braided polymer. Polyglactic acid is much less reactive and better able to resist infection from contaminating bacteria. It has excellent safety and maintains at least 50% of its tensile strength for approximately 25 days.⁴

In the past, topical cyanoacrylate adhesives were used in combination with or as an alternative to sutures in wound closure. The adhesive remains liquid until it is exposed to water or water-containing substances/tissues, after which it polymerizes and forms a bond with the underlying surface. The tissue adhesive has been shown to act as a barrier to microbial penetration as long as the adhesive film remains intact.⁵ Tissue adhesives such as Indermil and Histoacryl were the first medical-grade glues to be used, and these are composed of n-butyl cyanoacrylate. They were effective but had the disadvantage of having to be stored in the refrigerator, were exothermic so they stung the patient, and the bond was brittle.^{6,7}

87 Currently, the longer chain polymer 2-octyl cyanoacrylate is the preferred medical-grade
88 adhesive. It is available under various trade names, such as LiquiBand, SurgiSeal, FloraSeal,
89 and Dermabond.⁸

90 Dermabond tissue adhesive (Ethicon Inc., Somerville, NJ) is a liquid monomeric formulation
91 of 2-octyl cyanoacrylate that undergoes an exothermic reaction upon exposure to moisture,
92 changing to polymers that form strong tissue bonds. It has the advantages of being more
93 flexible, making a stronger bond, and easier to use. The longer side chain types, for example,
94 the octyl and butyl forms, also reduce the degree of tissue reactions.^{7,8} The adhesive film
95 formed from the polymerization of the liquid produces a strong tissue bond with a protective
96 barrier that adds strength and inhibits bacterial infection. An in vitro study revealed that glue
97 inhibits both gram-positive (methicillin-resistant *Staphylococcus aureus* and *S. epidermidis*)
98 and gram-negative (*Escherichia coli*) bacteria.⁵ In addition, tissue adhesives have the
99 potential advantages of rapid application and repair time. Scant evidence is available
100 regarding wound outcomes following the use of tissue adhesives for skin closure at caesarean
101 section despite their widespread use in other surgical specialties.^{9–11}

102 Caesarean section (CS) is one of the most common major surgical procedures performed
103 worldwide and is the most common surgical procedure among women of reproductive age.¹²
104 Over the years, the rate of this procedure has risen exponentially. Importantly, skin wound
105 closure influences several aspects of the postoperative course of patients, including
106 postoperative pain, wound healing, cosmetic outcomes, and patient satisfaction.¹³ Despite
107 this, there is currently no definite evidence regarding the best method for skin closure after
108 CS.^{13–15} Compared with traditional sutures, tissue adhesives have been used in various other

surgical specialties, and studies have shown their benefits.¹⁶⁻¹⁸ However, very few studies have been performed among the obstetric population and black people.¹⁹ Some studies revealed that the use of tissue adhesives was associated with less postoperative pain, a shorter operation time, and greater patient satisfaction than the use of sutures.²⁰⁻²² The cosmetic outcomes and wound complications, including hematoma, seroma, wound separation dehiscence, infection, closure time, and operation time, have also been studied, with dissenting findings.¹⁸ Therefore, the results of these studies and clinical trials have been inconclusive, and the selection of skin closure material is still the choice of the surgeon, the area of skin closure, and other factors, such as patient and wound factors.¹⁸

The available literature, therefore, leaves some knowledge gaps to be filled. Some of these include the heterogeneous nature of the study methodologies as well as the retrospective nature of some of the studies, with the associated limitations of selection and recall bias. Additionally, no study has compared the outcomes of the use of tissue adhesives and sutures for caesarean section in black populations in light of the differences in skin properties (higher total epidermal water loss, variable blood vessel reactivity, decreased skin surface pH, and larger mast cell granules compared with those in white-skinned populations) and wound healing between black and white populations.^{23,24} There are still no conclusive universal recommendations on the optimal skin closure material.²⁵ This study, therefore, compared the cosmetic outcomes and patients' satisfaction with skin wound closure via either tissue adhesive or subcuticular absorbable sutures during elective cesarean section with the aim of determining the effects of each skin closure technique on wound outcome in a dark-skinned population.

131

132 **METHODS**

133 *Aim*

134 The broad aim of this study was to determine the cosmetic outcome of the wound closure
135 technique and patient satisfaction with the use of tissue adhesives compared with subcuticular
136 absorbable sutures at discharge and 6 weeks post-operation. The specific objectives were to
137 assess the cosmetic outcome of the scar for each wound closure technique by an independent,
138 blinded observer; to determine the rate and types of wound complications associated with
139 each wound closure technique; and to assess patients' satisfaction with each wound closure
140 technique and scar appearance of the wound.

141 *Study design*

142 The study was a single-blinded superiority randomized controlled trial. The participants were
143 randomized into two arms: tissue adhesive (Group 1) and subcuticular suture (Group 2) arms.
144 An independent observer, a consultant plastic surgeon experienced in wound assessment, was
145 blinded in the study to assess scarring via the verified Patient and Observer Scar Assessment
146 Scale (POSAS) tool.²⁶

147 *Study setting*

148 The study was conducted at University College Hospital (UCH), Ibadan, Southwest Nigeria.
149 The UCH Ibadan is a tertiary health facility that offers multidisciplinary care to women in
150 Ibadan, Oyo state. It attends to patients, including junior and senior civil servants and other

members of the populace. The services are provided by midwives, nurses, interns, resident doctors, and consultants.

The obstetric wards of the department have a total of 94 bed spaces for admission. An average of 3000 admissions occur per year, with approximately 900 caesarean sections performed annually. Approximately one-third of these procedures are elective lower segment Caesarean section, which makes up our study population. The study was conducted over a period of eight months from August 2022 to March 2023 after the last trial participant was recruited.

Inclusion and exclusion criteria

Pregnant women who had an elective caesarean section that was 18 years and above and who had the ability and willingness to provide consent and return for follow-up evaluation were included in the study, while pregnant women with previous CS using a midline incision; clinical signs of infection at the time of CS, which included fever, abdominal tenderness, and foul-smelling vaginal discharge; uncontrolled diabetes mellitus (defined as haemoglobin A1c > 6%, poorly controlled blood glucose measurements, and fasting glucose >95 mg/dl); history of keloid formation; known hypersensitivity to the suture material or tissue adhesive used in the protocol; tattoos on the studied skin area; BMI ≥ 30 kg/m² at recruitment; any disorders requiring the use of chronic corticosteroids or immune suppressants; and other conditions that impair wound healing, such as sickle cell anaemia, other causes of anaemia, HIV, were excluded from the study.

Sample size calculation

This value was calculated via the following formula for superiority interventional studies:

$$n \geq 2x \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 (\sigma_1^2 + \sigma_2^2/r)}{(\mu_1 - \mu_2)^2}$$

$$(\mu_1 - \mu_2)^2$$

El-Maraghy et al. performed a similar study in 2021 in which cosmetic outcomes were compared between Dermabond tissue adhesive and Monocryl.²⁷ Therefore, α : Type 1 error rate=0.05; β : Type 2 error rate=0.2; μ_1 : mean of the outcome in the tissue glue group =2.35; σ_1 : standard deviation of the outcome in the tissue glue group =0.48; μ_2 : mean of the outcome in the suture group= 2.62; σ_2 : standard deviation of the outcome in the suture group =0.75; and r: sample size ratio group 2/group 1 =1.

The power analysis for this study was based on the assumption that a 20% difference (5 points) in the POSAS score would influence clinical decisions regarding the preferred method for skin closure, similar to a previous study that used this scoring system.²⁷ The minimum sample size for this study was 86 participants for each arm of the study, with a confidence interval of 0.05 and 80% power. Given a 10% attrition rate, the expected sample size was 96 participants in each arm.

Randomization

Participants were recruited into the study after ensuring that they met the inclusion criteria for the study. The recruited participants were randomized to either skin closure with tissue adhesive (group 1) or suturing (group 2) on the day of surgery via a table of random numbers generated from a computer-based program on www.randomization.com via randomization in blocks of four. The generated random numbers were concealed in sequentially sealed opaque envelopes. Allocation to either group was based on the group number in the sealed envelope.

Blinding

This was a single-blinded trial in which an independent observer (plastic surgeon) who assessed the scar appearance was blinded to the skin closure material used. This was accomplished by taking photographs at a constant distance (60 cm) and focal length of a camera (Galaxy A32; SM-A325F Camera- 64 MP, f/1.8) at 6 weeks for assessment by the observer via the observer scale of the patient and observer scar assessment scale.

Study outcomes

a. Primary: These variables included the cosmetic appearance of the skin wound and patient satisfaction following elective caesarean delivery using a patient and observer scar assessment scale (POSAS) among randomized patient groups.

b. Secondary: These included postoperative pain, duration of surgery, duration of hospitalization after the CS, and complications such as surgical site infection (SSI) or wound disruption (hematoma or seroma).

Surgical Procedure and Postoperative Care

a. Procedure: The same brand of amoxicillin/clavulanate (Fleming) 1.2 grams stat dose was administered to all patients within 60 minutes before skin incision for prophylaxis as per the protocol in the study centre. A Pfannenstiel incision was used in all patients, while patients with previous CS scars underwent excision of the scar. The subcutaneous tissue and fascia were opened via blunt dissection, while sharp dissection was performed with scissors. The

rectus muscle was separated at the midline, the parietal peritoneal layer was opened via sharp dissection, and the paracolic gutters were packed bilaterally with abdominal packs. The visceral peritoneal layer was dissected, and the bladder was reflected downwards via a Doyen retractor. A curvilinear incision was made on the lower uterine segment to deliver the foetus and other products of conception. The uterus was closed in two layers via polyglactin 910 number 2 sutures, after which the abdominal packs were removed. The rectus sheath was closed via a polyglactin 910 number 1 suture according to the protocol at the study center. In both groups, after the closure of the rectus sheath, the subcutaneous fat layer was closed if it was estimated to be more than 2 cm in thickness with 4–5 interrupted absorbable sutures via a Vicryl 2–0 suture with a size 26 mm needle (polyglactin 910 suture; Ethicon, Somerville, NJ). Hemostasis was ensured in the subcutaneous tissue layers via polyglactin 910 number 2–0 suture.

b. Skin Closure: In the tissue adhesive group (Group 1), two (2) layers of Dermabond (Ethicon Inc., Somerville, NJ) were used to close the skin. In accordance with the manufacturer's recommendations, the first layer of glue was applied to appose the skin edges. Thirty seconds later, a second layer was added to improve the strength of the skin apposition and to create the barrier intended to decrease the incidence of wound infections. The wound was not dressed according to the manufacturer's instructions as shown in Figure 1.

[Location for Figure 1]

In the suture group (Group 2), the skin was sutured with Vicryl 2-0 (polyglactin 910 suture; Ethicon, Somerville, NJ) placed under the skin via the subcuticular suturing technique. Participants had their wounds cleaned with chlorhexidine and methylated spirit, after which

the wound was covered with sterile gauze and adhesive plaster, which was placed along the entire incision site.

c. Postoperative care: Postoperative pain was managed with intramuscular pentazocine (60 mg, 6 hours for 48 hours) and piroxicam (20 mg, 12 hours for 48 hours) as routine postoperative analgesics for cesarean section at UCH, Ibadan. These were substituted with the oral analgesics oral diclofenac and acetaminophen after 48 hours. The participants also received perioperative antibiotics, such as intravenous amoxicillin-clavulanate (600 mg) 8 hours per hour for 48 hours, oral 625 mg b.d. for 5 days (as is routinely done in the study center), and intravenous fluid therapy with IV 0.9% normal saline (1 Liter) 8 hours per hour, alternating with 4.3% dextrose saline (1 Liter) 8 hours per hour for 24 hours. Patient ambulation was initiated on the first postoperative day, and the wound dressing for the suture group was also removed on the first postoperative day as per the protocol in the study center as shown in Figure 2

[Location for Figure 2]

Three senior resident Doctors who were on their labour ward postings and were interested in the study were included. They were trained on the appropriate techniques and materials for subcuticular wound closure and Dermabond application to ensure the uniformity of the technique and approach used in the study.

Two nurses (research assistants) were trained in the study protocol and how to interview the participants on wound assessment on day 1, at discharge, and 6 weeks post-partum via the patient scale of the Patient and Observer Assessment Scale and administered the proforma

content at various time points. The circulating nurse noted the time from the commencement of skin closure for each arm to the completion of the surgery.

Pain was assessed via the box numerical scale on the first and fourth postoperative days and at 6 weeks post-partum. The need for additional parenteral analgesics and duration was noted. Additionally, a total of three wound reviews of the participants were donated by the research assistant. The schedule for the follow-up included the end of day 1, day 4, and week 6. The wound site was inspected at each review for discharge, hyperaemia, and apposition.

The patient satisfaction scale was used to assess the level of patient satisfaction with each closure technique at 6 weeks. This scale ranges from 1–5 and consists of very unsatisfied, unsatisfied, indifferent, satisfied, and very satisfied, respectively.

The appearance of the scar was also evaluated at 6 weeks after the caesarean section by both the patient and a plastic surgeon (blinded independent observer) .This was done by taking photographs at standard camera settings (Galaxy A32; SM-A325F Camera- 64 MP, f/1.8) and constant distance(60cm) as shown in figures 3 and 4. This was done via the patient and observer scar assessment scale (POSAS).^{28,29} The Observer Scar Assessment Scale rates 5 variables: vascularity, pigmentation, thickness, relief, and pliability. Each variable is ranked from 1-10, with 1 representing normal skin. The ratings are summed to obtain a total score ranging from 5-50. The Patient Scar Assessment Scale consists of 6 items: scar-related pain, itchiness, color, stiffness, thickness, and irregularity. Each item is ranked from 1-10, with 1 representing normal skin. The total score ranges from 6-60. The primary outcome of the study was the POSAS score 6 weeks after the CS.

[Location of figure 3]

[Location of Figure 4]

The secondary outcomes were postoperative pain, duration of skin wound closure, wound infection, wound separation, dehiscence, haematoma, seroma, and other complications, such as surgical site infection (SSI), which were determined via the 2017 Centre for Disease Control and Prevention Criteria for the Assessment of Surgical Site Infection.³⁰

Data collection

Each patient's clinical history and postoperative review were documented on a structured data collection form (proforma). This was administered by trained research assistants. The data collection form contains demographic data, brief clinical history, and questions in various categories that are assessed: history of index pregnancy and identification of risk, past obstetric history, indication for caesarean section, and brief intraoperative details, including operation time and closure time. The estimated blood loss, state of the liquor, subcutaneous fat layer thickness, number of tissue adhesive tubes used, and length of the leftover suture were also assessed. Other postoperative details, such as post-operative analgesia, perioperative antibiotics, the need for additional analgesia and pain assessment, were also recorded by the research nurses.

Data Management

The collected data were cleaned, entered, and computer analysed with Statistical Package for Service Solutions version 23 (IBM Inc. New York, United States). The variables were summarized using frequencies, interquartile ranges, and proportions for qualitative variables, whereas means and standard deviations were used for quantitative variables. Differences in

outcomes were compared between the two groups via the significance tests student's T-test, chi-square test, and Fisher's exact test for normally distributed data and the Mann–Whitney U test for skewed data. A level of significance of 5% was used for all tests.

Ethical Consideration

This study was conducted with the approval of the Institution Review Board (IRB) of the University of Ibadan/University College Hospital (IRB number: UI/EC/22/0063). Only patients who provided consent following adequate and clear language counselling were recruited for the study. The consent form was translated to the local language. All data collection was performed by the research assistants from the patients' medical records, and details were obtained from the participants. The consent forms, pain assessment forms, and scar assessment forms were all translated into the local language (Yoruba) in this environment for ease of communication and comprehension of the study by the participants, who could not communicate in English.

Ethical principles

The following ethical principles were applied was conducted in accordance with the Declaration of Helsinki (2013 revision) and the International Conference on Harmonisation – Good Clinical Practice (ICH-GCP) guidelines

Beneficence:

Participants on the tissue adhesive arm would have benefitted from the perceived advantages it has over subcuticular sutures. However, there was no additional benefit for those on the subcuticular sutures arm above what is known already.

Non-maleficence:

There was no harm to the patient who participated above what is known in either arm of the research as the two methods of skin closure compared are standards of care in different centres.

Justice:

There was also fairness to all patients regardless of their consent to participate in the study.

Confidentiality of data:

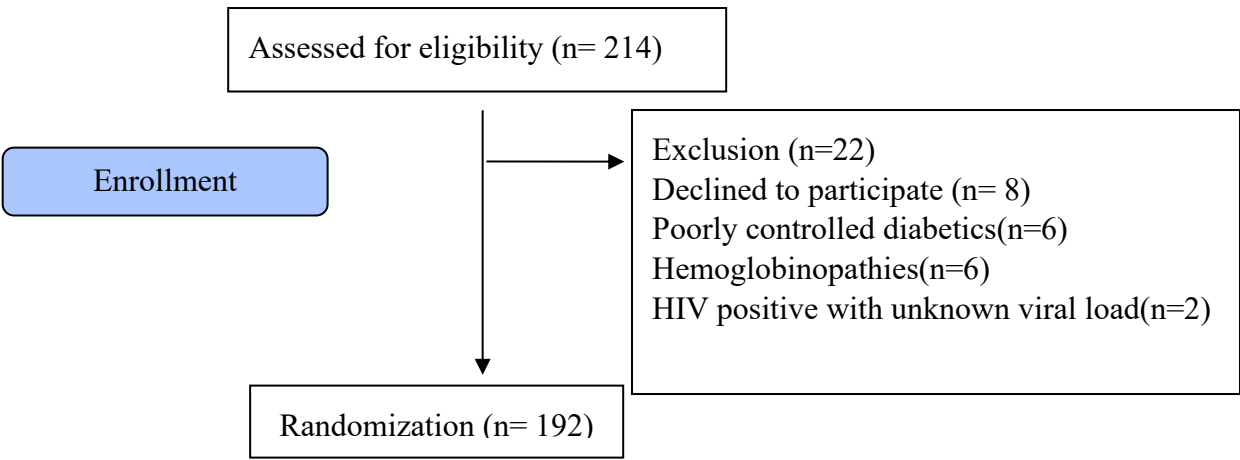
All information obtained from the patients including personal and clinical details was treated with confidentiality.

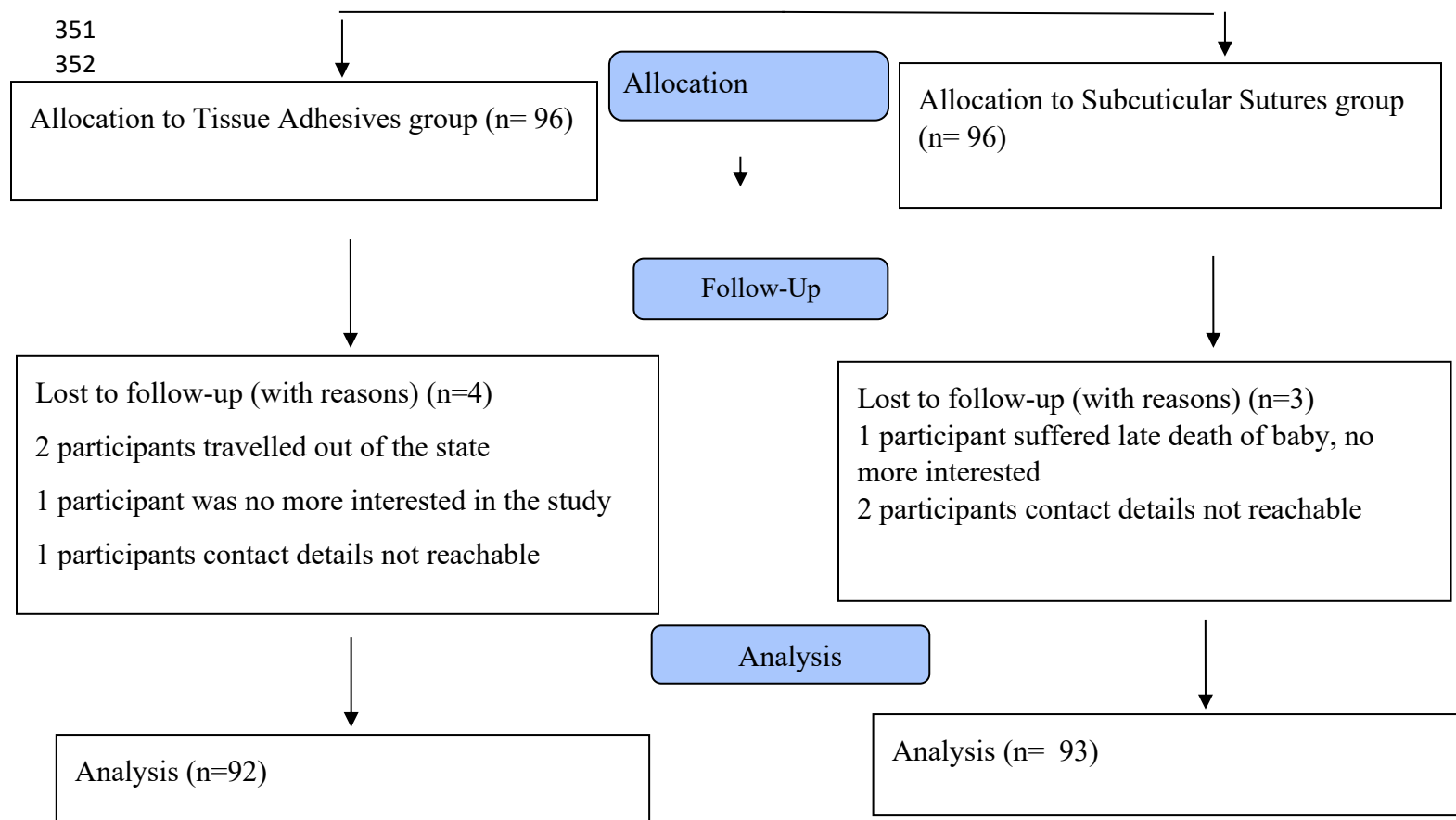
Informed Consent/ Voluntariness: The patients were counselled and participation in the study was voluntary and free of any form of coercion.

The patients were also free to decline participation and to withdraw or opt out of the study at any stage without any risk of loss of benefit or negative impact on their management.

RESULTS

CONSORT FLOW CHART





Sociodemographic characteristics of the participants

A total of 192 participants were recruited, but 185 participants completed the study. As shown in Table 1, the sociodemographic characteristics of the two groups were similar. The mean age and marital status of the participants were similar in both groups. The majority (76 (83.5%) and 80 (86.0%) of the participants in the tissue adhesive group and subcuticular suture group, respectively, had tertiary education, although the difference was not statistically significant ($p=0.57$). Similarly, there was no significant difference in the religion ($p= 0.58$) of the participants in the two groups.

Table 1: Sociodemographic characteristics among participants

Variables	Wound Closure technique		Chi-Square	p-value
	Tissue Adhesives Group (n=92)	Subcuticular Sutures group (n=93)		
Age (Years)				
Mean± SD	32.7±5.2	32.1±5.6	0.65****	0.52
Educational Status				
None	1(1.1)	0(0.0)	1.09	0.57
Primary	0(0.0)	0(0.0)		
Secondary	14(15.4)	13(14.0)		
Tertiary	76(83.5)	80(86.0)		
Religion				
Christianity	67(72.8)	67(72.0)	1.08	0.58
Islam	24(26.1)	26(28.0)		

Others	1(1.1)	0(0.0)		
Ethnic Group				
Yoruba	79(85.9)	80(86.0)	0.17	0.92
Igbo	9(9.8)	8(8.6)		
Others	4(4.3)	5(5.4)		

****student-t test

Relevant medical and surgical history of the participants

Table 2 shows no statistically significant difference in genotype between the two groups. (p=0.76). Similarly, the variation in the blood groups of the participants between the two groups was not statistically significant (p=0.39). The rates of preexisting medical conditions in the index pregnancy were similar in both groups. There was also no statistically significant difference in the obstetric characteristics of the participants in either group.

371 **Table 2: Relevant medical and surgical history**

Variable	Wound Closure technique		Chi-square	p-value
	Tissue Adhesives Group (n=92)	Subcuticular Sutures group (n=93)		
Genotype				
AA	61(66.3)	65(69.9)	1.87	0.76
AS	27(29.4)	22(23.7)		
AC	4(4.3)	6(6.5)		
Blood group				
A Positive	14(15.2)	12(12.9)	6.35	0.39
B Positive	23(25.0)	18(19.4)		
AB	3(3.3)	10(10.8)		
O Positive	40(43.5)	46(49.5)		
O negative	4(4.3)	2(2.2)		
B Negative	6(6.5)	4(4.3)		
A negative	2(2.2)	1(1.1)		
Parity				
0	30(32.6)	27(29.0)	3.39	0.50
1	23(25.0)	32(34.4)		
2	32(34.8)	24(25.8)		
3 or more	7(7.6)	10(10.8)		
Hypertension				
Yes	4(4.3)	2(2.2)	0.18	0.67*
No	88(95.7)	97.8)		
Diabetes				
Yes	2(2.2)	2(2.2)	0.00	1.0*
No	90(97.8)	91(97.8)		
Epilepsy				
Yes	4(4.3)	1(1.1)	0.85	0.36*
No	88(95.7)	92(98.9)		
Previous CS				
Yes	46(50.0)	53(57.0)	0.91	0.34
No	46(50.0)	40(43.0)		

372 *Yates Correction

373

374

375

376 **Patient and Observer Scar Assessment Scale at 6 Weeks**

Table 3 shows the scores of the patients' and observers' scar assessments at 6 weeks. Patient scar assessment revealed that there was no significant difference in pain ($p=0.39$ vs $p=0.80$) or itchiness between the tissue adhesive group and the subcuticular suture group. However, color ($p=0.004$), stiffness ($p<0.001$), thickness ($p<0.01$), and irregularity (<0.01) were significantly associated with the wound closure technique used. A significant difference was also found in the total patient scar assessment score between the tissue adhesive group and the subcuticular group ($p=0.01$).

With respect to the observer scar assessment scale, there was no significant difference in thickness, relief, pliability, skin pigmentation, vascularity, or total observer scar assessment scale score between the tissue adhesive group and the subcuticular suture group.

Table 3: Patient and observer scar assessment scale scores at 6 weeks

Variable	Wound Closure technique		Mann Whitney U test	p-value
	Tissue Adhesives Group Median (IQR) (n=92)	Subcuticular Sutures group Median (IQR) (n=93)		
Pain	1(1,2)	1(1,2)	3969.50	0.39
Itchiness	1(1,2)	1(1,2)	4150.50	0.80
Colour	2(1,2)	2(1,3)	3256.00	0.004
Stiffness	1(1,2)	2(1,2.5)	3123.00	<0.001
Thickness	1(1,2)	2(1,3)	3159.00	<0.01
Irregularity	2(1,2)	2(1,3)	3281.00	<0.01
Total PAS score	9(7,11)	10(8,14)	3285.50	0.01

Observer Scar Assessment Scale				
Thickness	2(1,2)	2(1,2)	4059.50	0.59
Relief	2(1,2)	2(1,2.5)	4073.50	0.64
Pliability	1(1,2)	1(1,2)	4041.50	0.55
Skin pigmentation	2(1,2)	2(1,3)	3720.50	0.14
Vascularity	2(1,2)	2(1,3)	3786.00	0.20
Total OSAS score	8(7,11)	8(6,13)	3988.50	0.50

Types of wound complications associated with the wound closure technique

The rates of wound complications experienced by the participants in this study are shown in Table 4. These include postpartum fever, seroma, wound separation, and wound dehiscence. The table further shows that none of the wound complications were associated with the wound closure technique used.

Table 4: Types of wound complications associated with the wound closure technique

Variable	Wound Closure technique		Yates correction	p-value
	Tissue Adhesives Group n (%)	Subcuticular Sutures group n (%)		
Postpartum Fever day4 Yes No	5(3.4) 87(94.6)	3(3.2) 90(96.8)	0.14	0.46
Seroma day 4 Yes No	0(0.0) 92(100.0)	1(1.1) 92(98.9)	0.00	1.00
Wound separation day 4 Yes	1(1.1) 92(98.9)	0(0.0) 92(100.0)	0.00	1.00

No				
Wound Dehiscence day 4				
Yes	1(1.1)	0(0.0)		
No	92(98.9)	93(100.0)	0.00	1.00
Postpartum Fever week 6	2(2.2)	5(5.4)	0.00	0.44
Yes	89(97.8)	88(94.6)		
No				
Haematoma week 6	1(1.1)	1(1.1)	0.00	1.00
Yes	91(98.9)	92(98.9)		
No				
Seroma week 6			0.00	1.00
Yes	1(1.1)	2(2.2)		
No	91(98.9)	91(97.8)		
Wound separation week 6				
Yes	2(2.2)	3(3.2)	0.00	1.00
No	90(97.8)	90(96.8)		
Wound Dehiscence week 6				
Yes	4(4.3)	0(0.0)	2.33	0.06
No	88(95.7)	93(100.0)		
Wound infection week 6				
Yes	1(1.1)	0(0.0)		
No	92(98.9)	93(100.0)	0.00	1.00

Patient satisfaction and pain perception with each wound closure technique

Patient satisfaction with each wound closure technique and the scar appearance of the wound are shown in Table 5. There was no significant association between patient satisfaction and the type of wound closure method used ($P=0.95$).

The pain score at six hours post-operation was significantly greater in patients in the tissue adhesive group than in those in the subcuticular suture group ($p=0.03$). However, on postoperative day 1, the pain score was significantly greater among patients in the subcuticular suture group than among those in the tissue adhesive group ($p<0.001$). No significant difference

in pain was detected between the tissue adhesive group and the subcuticular suture group on postoperative day 4 ($p=0.11$) or 6 weeks post-operation ($p=0.27$).

Table 5: Patient satisfaction and pain perception according to the wound closure technique and scar appearance

Variable	Wound closure technique		Mann Whitney u test	p-value
	Tissue adhesive Group Median (IQR*) (n=92)	Subcuticular suture group Median (IQR*) (n=93)		
Patient's satisfaction	4(4,5)	4(4,5)	4211.50	0.95
Patient's pain				
Six hours post-operation	3(2,4)	2(2,4)	3523.50	0.03
Post-operative day 1	2(1,3)	3(2,4)	2850.00	<0.001
Post-operative day 4	1(1,1)	1(1,2)	3812.00	0.11
6 weeks post-operation	0(0,1)	0(0,1)	3905.00	0.27

5-point Likert scale on which 1 is completely dissatisfied and 5 is completely satisfied,

IQR* =Interquartile range

Surgical characteristics of the tissue adhesive and subcuticular sutures

Table 6 shows the surgical characteristics of the patients in the tissue adhesive and subcuticular suture groups. There was no significant difference in the preoperative packed cell volume (PCV) between the study groups (34.3 ± 4.2 vs 34.5 ± 2.4 , $p=0.64$).

There was no significant difference in intraoperative blood transfusion between those in the tissue adhesive group and those in the subcuticular suture group ($p=1.00$). The duration of surgery from skin incision to skin closure was 49.85 ± 58.34 sec in the tissue adhesive group, whereas it was 44.22 ± 15.62 sec in the subcuticular suture group, which was not statistically significant ($p=0.37$). However, the mean duration of skin wound closure from onset to completion of closure was significantly shorter in the tissue adhesive group (3.32 ± 2.27) than in the subcuticular suture group (6.52 ± 2.97) ($p<0.01$). Similarly, the number of patients who needed additional analgesia was significantly greater in the subcuticular suture group ($p<0.001$) than in the tissue adhesive group. There was no significant difference between the two study groups in terms of intraoperative delay ($p=0.14$), estimated blood loss ($p=0.74$), postoperative PCV ($p=0.29$), or subcutaneous fat layer thickness ($p=0.24$).

Table 6: Surgical characteristics of the adhesive and subcuticular sutures

Variables	Wound closure technique		Test	p-value
	Tissue adhesive group (n=92)	Subcuticular suture group (n=93)		
Pre-operative PCV Mean $\pm$ SD	34.28 ± 4.19	34.52 ± 2.37	-0.47	0.64**
Intra-operative Blood transfusion			0.00	1.00*
Yes	2(2.2)	3(3.2)		
No	90(97.8)	90(96.8)		
Duration of surgery (from skin incision to skin closure) Mean $\pm$ SD	49.85 ± 58.34	44.22 ± 15.62	0.89	0.37**
Duration of wound closure time (from onset to completion of closure)				

Mean±SD	3.32 ±2.27	6.52±2.97	-8.21	<0.01**
Total duration (from skin incision to completion of closure)				
Mean±SD	53.16±58.52	50.74±17.08	0.38	0.70**
Intra-operative delays				
Yes	3(3.3)	9(9.7)	2.17	0.14*
No	89(95.7)	84(89.2)		
Estimated Blood Loss(mls)	399.46±156.63	392.47±208.64	0.26	0.74**
Post-operative Blood transfusion				
Yes	0(0.0)	1(1.1)	0.00	1.00*
No	92(100.0)	91(98.9)		
Post-operative PCV (Mean±SD)	32.98±2.77	36.5±31.79	-1.06	0.29**
Subcutaneous fat layer thickness				
<2cm	40(44.0)	33(35.5)	1.38	0.24*
>2cm	51(56.0)	60(64.5)		
Need for additional analgesia				
Yes	7(7.6)	41(44.1)	32.03	<0.001***
No	85(92.4)	52(55.9)		

*Yates correction, **t test, ***Chi square test.

DISCUSSION

The main findings from the study are that the cosmetic outcome of wound closure via the POSAS scale and patient satisfaction were not significantly different between participants who had tissue adhesive and those who had subcuticular sutures for skin wound closure. Although the need for additional analgesia and duration of skin wound closure were significantly lower in the tissue adhesive group, there was no significant difference in the incidence or types of wound complications associated with the use of either type of skin wound closure technique. The sociodemographic characteristics of the participants in both groups were not significantly different. The medical and surgical history, blood group, genotype, and prevalence of chronic

medical conditions of the participants were evenly distributed between the two groups. This finding was similar to the findings of earlier studies.^{2,7,8,31}

This study reported a significantly lower occurrence of thick scars, stiffness, irregularity, and scar color in the tissue adhesive group than in the normal skin group according to the POSAS score at 6 weeks. In contrast, there was no significant difference in the incidence of scar pain or itchiness. The cumulative assessment of the scars revealed that the surgical scar appearance was better in the tissue adhesive group than in the subcuticular group. However, the blinded observer assessment revealed no significant difference between the two groups. The contrast in the findings of the participants and the independent observer could have been a result of observation bias that might have influenced the judgement of the participants who were not blinded to the study. El-Maraghy et al reported that the overall POSAS scores for both the tissue adhesive and suture groups were not significantly different; however, pain and itchiness at the patient scale as well as vascularity and thickness at the observer scale were better in the tissue adhesive group.²⁷ A similar study that used the POSAS reported no significant difference for either group, although each component of the scale was not analysed separately in that study.⁸

The incidence of wound complications was generally low in this study. The rate of wound dehiscence was greater in the tissue adhesive group than in the control group, although this difference was not statistically significant. This finding was similar to that of the study by Kwon et al.⁷, although the incidence of wound dehiscence was greater among the participants who had histoacryl tissue adhesive than among those who had subcuticular sutures; likewise, there was no significant difference. In another study by Gennari et al., none of the participants in either group experienced wound complications.³² However, a Cochrane review by Dumiville et al provided low evidence of less wound dehiscence with sutures than with other methods of skin wound closure, although the clinical significance of this finding was not stated.¹⁴ Conversely, the

incidence of postpartum fever was greater in the subcuticular group at the 6th postpartum week than at discharge. This may be due to the possibility of a tissue reaction during suture breakdown in the skin. This was demonstrated in an earlier study in which participants who had subcuticular sutures were shown to have a significantly greater incidence of wound erythema and seroma.³²

This study reported no significant difference in patient satisfaction among participants in either group. Mora-Galvan et al. and Rahman et al. described similar findings.^{2,33} Additionally, a systematic review and meta-analysis comparing tissue adhesives and suturing following arthroplasty by Balgovind et al reported similar findings.³⁴ The need for additional analgesia was significantly greater in the subcuticular group, possibly because multiple needles prick on the skin during suturing from the high concentration of pain fibres on the skin. Additionally, tissue adhesive is known to form a water-tight film on the wound surface, which allows better tissue fixation. This leads to fast and complete epithelization with rapid apoptosis of inflammatory cells, resulting in a reduction in scarring and maintenance of skin elasticity. This could further explain the significant decrease in pain among our women in the tissue adhesive group compared with the suture group. The findings of this study were similar to those of the study by Rahman et al. in 2022, where the pain score in the tissue adhesive group was significantly lower than that in the suture group.³³ Additionally, El-Maraghy et al reported significantly better postoperative analgesia in participants who received tissue adhesives in their study.²⁷ The assessment of participants' pain perception in both groups revealed a significantly greater incidence of postoperative pain at six hours post-surgery in the tissue adhesive group. However, by the first postoperative day, the patients in the tissue adhesive group had significantly better pain control. This may be due to the initial skin irritation caused by the exothermic reaction that occurs in the process of solidification of the adhesives, which is transmitted by the pain fibres in the skin.

The participants in both groups had similar average packed cell volumes and rates of intraoperative transfusion. Similar findings were reported by Rahman et al. and El-Maraghy et al.³¹ The duration of skin closure was significantly lower in the tissue adhesive group; this is most likely due to the ease of application and the speed of application to achieve the desired outcome. This finding was similar to that of Gennari et al.; however, only the duration of skin wound closure was compared, and the participants had various lengths of wounds in their study. The time savings of the total surgery duration was shown to be significantly greater in the tissue adhesive group, even with longer incisions, in the same study.³⁵ Additionally, Rahman et al reported that both the duration of skin wound closure and the total duration of surgery were significantly shorter in the tissue adhesive group.³³ Similarly, El-maraghy et al reported a significant time savings of approximately eight minutes at skin wound closure using tissue adhesive in their study.²⁷ A Cochrane review by Dumville et al provided low-level evidence for a shorter overall surgery time in favour of tissue adhesives on average of approximately 10 minutes.¹⁴ In contrast, the study by Daykan et al⁸ reported similar total operation times for both groups, although a specific assessment of the duration of skin closure was not performed.

The strengths of this study include the fact that the randomization performed in the study was effective, as evidenced by the distribution of the demographic and clinical characteristics in both groups. The possible confounders in the study were eliminated as much as possible to reduce confounding bias. Although it was impractical to perform a double-blinded trial, the independent observer was blinded to the data to reduce the risk of observation bias.

This study was limited by several factors. Although the study was powered to answer the primary outcome measures, some of the secondary outcome measures could not be addressed fully due to the small sample size of the study regarding those outcomes. Additionally, the effects of previous surgical scars on the subcutaneous tissue and surrounding skin were not evaluated in

this study, as all previous scars were excised. The superior wound closure technique needs to be elucidated in patients with immunosuppression and other mitigation factors for wound healing to address the possible impact of the skin closure technique on the heightened risk of wound infection in this category of patients. The real-time assessment of the wound outcome by the blinded observer is ideal; however, to ensure blinding, a picture assessment was performed using high-resolution photographs, which have been shown to provide results similar to those of real-time assessment.³⁶

CONCLUSION

The cosmetic outcome and patient satisfaction with the use of tissue adhesive for skin wound closure were not shown in this study to be superior to the use of subcuticular sutures. Although pain control was significantly better with tissue adhesives, the rate of wound complications was similar in both groups. Therefore, tissue adhesive remains a good alternative to subcuticular suture as a skin wound closure technique at caesarean section, as they offer similar cosmetic outcomes and patient satisfaction.

Although the scar cosmetic outcome and overall patient satisfaction with the use of tissue adhesives are not superior to those of subcuticular sutures, it therefore remains an alternative to the use of subcuticular sutures, especially because of the lower risk of needle-stick injury and ease of application associated with its use.

The merits of tissue adhesives in reducing the risk of wound infection could also be explored in women with immunosuppression, obesity, and those women with midline incisions as well as those with poorly controlled medical conditions during pregnancy.

544 **LIST OF ABBREVIATIONS**

545 BMI - Body mass index

546 CS - Caesarean section

547 HIV - Human immunodeficiency virus

548 IBM - International business machine

549 IM - Intramuscular

550 IMRAT - Institute for Advanced Medical Research and Training

551 IQR -Interquartile range

552 IRB - Institutional Review Board

553 IV - Intravenous

554 NJ - New Jersey

555 POSAS - Patient and observer scar assessment scale

556 SSI - Surgical site infection

557 UCH - University College Hospital

558 USA - United States of America

559

560

561

562 **DECLARATION**

563 Ethics approval certificate



INSTITUTE FOR ADVANCED MEDICAL RESEARCH AND TRAINING (IAMRAT)
College of Medicine, University of Ibadan

Director: **Prof. IkeOluwapo O. Ajayi**,
MBBS (Ib), M. CI.Sc., Ph.D, MD, FMCGP, FWACP
Tel: 08023268431

E-mail: ikeajayi2003@yahoo.com



UI/UCH EC Registration Number: **NIHREC/05/01/2008a**

NOTICE OF FULL APPROVAL AFTER FULL COMMITTEE REVIEW

Re: Outcome of skin wound closure using tissue adhesives versus subcuticular absorbable sutures at elective caesarean section: Randomized Controlled Trial

UI/UCH Ethics Committee assigned number: **UI/EC/22/0063**

Name of Principal Investigator: **Dr J. E. Ifebude**

Address of Principal Investigator: Department of Obstetrics & Gynaecology
University College Hospital, Ibadan

Date of receipt of valid application: **23/02/2022**

Date of meeting when final determination on ethical approval was made: **N/A**

This is to inform you that the research described in the submitted protocol, the consent forms, and other participant information materials have been reviewed and *given full approval by the UI/UCH Ethics Committee*.

This approval dates from **05/04/2022 to 04/04/2023**. If there is delay in starting the research, please inform the UI/UCH Ethics Committee so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. *All informed consent forms used in this study must carry the UI/UCH EC assigned number and duration of UI/UCH EC approval of the study.* It is expected that you submit your annual report as well as an annual request for the project renewal to the UI/UCH EC at least four weeks before the expiration of this approval in order to avoid disruption of your research.

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the UI/UCH EC. No changes are permitted in the research without prior approval by the UI/UCH EC except in circumstances outlined in the Code. The UI/UCH EC reserves the right to conduct compliance visit to your research site without previous notification.



Professor IkeOluwapo O. Ajayi
Director, IAMRAT
Chairperson, UI/UCH Research Ethics Committee
E-mail: uiuchec@gmail.com

Research Units * Genetic & Bioethics * Malaria * Environmental Sciences * Epidemiology Research & Service * HIV/AIDS
* Behavioural & Social Sciences * Pharmaceutical Sciences * Cancer Research & Service * Neuroscience & Ageing Research

564

565

566 **Consent for Publication:**

567 Not Applicable

568 **Availability of Data and materials:**

569 The datasets used and/or analysed during the current study are available from the
570 corresponding author upon reasonable request.

571 **Competing interests**

572 The authors declare that they have no competing interests.

573 **Funding:**

574 This study was self-funded

575 **Author contributions:**

576 IJ – Design, planning, conduct, interpretation of results, and manuscript writing

577 OO – Design, planning, conduct, data analysis, interpretation of results, and manuscript
578 writing

579 AO – Design, planning, data analysis, interpretation of results, and manuscript writing

580 IA – Conducting and interpreting the results and writing the manuscript

581 OO – Data analysis, interpretation of results, and manuscript writing

582 All authors have read and approved the final manuscript.

583 **Acknowledgement**

584 We wish to express our profound gratitude to the Head of the Department of Obstetrics and
585 Gynaecology, Professor Akin-Tunde Odukogbe, and the entire consultant staff of the
586 Department of Obstetrics and Gynaecology, University College Hospital (UCH), Ibadan, for
587 their immense contribution to the execution of this study.

588

589

590 **Authors' information**

591 **IJ**

592 PostPart 2 Fellow
593 Department of Obstetrics and Gynaecology,
594 University College Hospital, Ibadan,
595 Oyo State, Nigeria

596
597 **OO**

598 Consultant/Associate Professor
599 Department of Obstetrics and Gynaecology,
600 College of Medicine, University of Ibadan,
601 Oyo State, Nigeria

602
603
604 **AO**

605 Consultant/Associate Professor
606 Department of Obstetrics and Gynaecology,
607 College of Medicine, University of Ibadan,
608 Oyo State, Nigeria

609
610 **IA**

611 Consultant/Senior lecturer
612 Department of Plastic, Reconstructive and Aesthetic Surgery,
613 University of Ibadan,
614 Oyo State, Nigeria

615
616
617 **OO**

618 Consultant
619 Department of Obstetrics and Gynaecology,
620 Federal Medical Centre, Abeokuta
621 Ogun State, Nigeria

622
623
624 **Footnotes**

625 Not applicable.

626
627
628 **REFERENCES**

- 629 1. Muffly TM, Tizzano AP, Walters MD. The history and evolution of sutures in pelvic
630 surgery. J R Soc Med. 2011;104(3):107–12.

- 631 2. Mora-Galvan JA, Reyes-Paredes N, Grosso-Espinosa JM, Ortiz-Ramirez MA,
632 Godines-Enriquez MS, Sepulveda-Rivera CM. Use of Cyanoacrylate N-Butyl Versus
633 Subcuticular Suture in the Dermal Closure Following Cesarean Delivery: A
634 Randomized Controlled Trial. *J Clin Gynecol Obstet*. 2019;8(3):85–90.
- 635 3. Gumbiner BM. Cell adhesion: The molecular basis of tissue architecture and
636 morphogenesis. *Cell*. 1996;84(3):345–57.
- 637 4. Chu CC. Types and properties of surgical sutures. In: *Biotextiles As Medical Implants*.
638 Elsevier Inc.; 2013. p. 231–73.
- 639 5. Bhende S, Rothenburger S, Spangler DJ, Dito M. In vitro assessment of microbial
640 barrier properties of Dermabond® topical skin adhesive. *Surg Infect (Larchmt)*.
641 2002;3(3):251–7.
- 642 6. Koonce SL, Eck DL, Shaddix KK, Perdakis G. A prospective randomized controlled
643 trial comparing N-butyl-2 cyanoacrylate (Histoacryl), octyl cyanoacrylate
644 (Dermabond), and subcuticular suture for closure of surgical incisions. *Ann Plast Surg*.
645 2015;74(1):107–10.
- 646 7. Kwon JY, Yun HG, Park IY. N-Butyl-2-cyanoacrylate tissue adhesive (Histoacryl) vs.
647 subcuticular sutures for skin closure of Pfannenstiel incisions following cesarean
648 delivery. *PLoS One*. 2018;13(9):e0202074.
- 649 8. Daykan Y, Sharon-Weiner M, Pasternak Y, Tzadikevitch-Geffen K, Markovitch O,
650 Sukenik-Halevy R, et al. Skin closure at cesarean delivery, glue vs subcuticular
651 sutures: a randomized controlled trial. *Am J Obstet Gynecol* [Internet].
652 2017;216(4):406.e1-406.e5. Available from:
653 <http://dx.doi.org/10.1016/j.ajog.2017.01.009>
- 654 9. Simonova G, Rickard CM, Dunster KR, Smyth DJ, McMilan D, Fraser JF.
655 Cyanoacrylate tissue adhesives - Effective securement technique for intravascular
656 catheters: In vitro testing of safety and feasibility. *Anaesth Intensive Care* [Internet].
657 2012 [cited 2021 Jul 21];40(3):460–6. Available from:
658 <https://journals.sagepub.com/doi/abs/10.1177/0310057X1204000311>
- 659 10. Ridgway DM, Mahmood F, Moore L, Bramley D, Moore PJ. A blinded, randomized,
660 controlled trial of stapled versus tissue glue closure of neck surgery incisions. *Ann R*
661 *Coll Surg Engl* [Internet]. 2007;89(3):242–6. Available from:
662 <https://publishing.rcseng.ac.uk/doi/abs/10.1308/003588407X179062>
- 663 11. Nose S, Sasaki T, Saka R, Minagawa K, Okuyama H. A sutureless technique using
664 cyanoacrylate adhesives when creating a stoma for extremely low birth weight infants.
665 *Springerplus*. 2016;5(1):1–5.
- 666 12. Blanchette H. The rising cesarean delivery rate in America: What are the
667 consequences? *Obstet Gynecol*. 2011;118(3):687–90.
- 668 13. Clay FSH, Walsh CA, Walsh SR. Staples vs subcuticular sutures for skin closure at
669 cesarean delivery: A metaanalysis of randomized controlled trials. *Am J Obstet*
670 *Gynecol*. 2011;204(5):378–83.
- 671 14. Dumville JC, Coulthard P, Worthington H V., Riley P, Patel N, Darcey J, et al. Tissue
672 adhesives for closure of surgical incisions. *Cochrane Database Syst Rev*.

673 2014;(11):CD004287.

674 15. Siddiqui DS, Lacuna EM, Chen HY, Chauhan SP. Skin closure of pfannenstiell incision
675 with dermabond, staples, or suture during cesarean delivery: Experience of a single
676 attending. *Am J Perinatol*. 2013;30(3):219–24.

677 16. Zhuang AR, Beroukhi K, Armstrong AW, Sivamani RK, Eisen DB. Comparison of
678 2-Octylcyanoacrylate Versus 5-0 Fast-Absorbing Gut during Linear Wound Closures
679 and the Effect on Wound Cosmesis. *Dermatologic Surg*. 2020;46(5):628–34.

680 17. Maw JL, Quinn J V., Wells GA, Ducic Y, Odell PF, Lamothe A, et al. A prospective
681 comparison of octylcyanoacrylate tissue adhesive and suture for the closure of head
682 and neck incisions. *J Otolaryngol*. 1997;26(1):26–30.

683 18. Goto S, Sakamoto T, Ganeko R, Hida K, Furukawa TA, Sakai Y. Subcuticular sutures
684 for skin closure in nonobstetric surgery. *Cochrane Database Syst Rev*. 2020;(4):1–188.

685 19. James O, Adekunle AA, Adeyemo WL. How Does Octyl-2-Cyanoacrylate Tissue
686 Adhesive Compare With Prolene Sutures in Cleft Lip Repair? *J Oral Maxillofac Surg*.
687 2021;79(7):1540–8.

688 20. Martin JG, Hollenbeck ST, Janas G, Makar RA, Pabon-Ramos WM, Suhocki P V., et
689 al. Randomized Controlled Trial of Octyl Cyanoacrylate Skin Adhesive versus
690 Subcuticular Suture for Skin Closure after Implantable Venous Port Placement. *J Vasc*
691 *Interv Radiol*. 2017;28(1):111–6.

692 21. Samal CC, Dash S, Agrawal K, Tandon R. Comparative evaluation of three methods
693 of skin graft fixation for split thickness skin graft after release of post burn contracture
694 of the neck. *Burns*. 2019;45(3):691–8.

695 22. Bartenstein DW, Cummins DL, Rogers GS. A prospective, randomized, single-blind
696 study comparing cyanoacrylate adhesives to sutures for wound closure in skin cancer
697 patients. *Dermatologic Surg*. 2017;43(11):1371–8.

698 23. Bliss DZ, Gurvich O, Savik K, Eberly LE, Harms S, Mueller C, et al. Racial and ethnic
699 disparities in the healing of pressure ulcers present at nursing home admission. *Arch*
700 *Gerontol Geriatr* [Internet]. 2017;72:187–94. Available from:
701 <http://dx.doi.org/10.1016/j.archger.2017.06.009>

702 24. Saggat S, Wesley NO, Moulton-Levy NM, Maibach HI. Ethnic differences in skin
703 properties: The objective data. *Handb Cosmet Sci Technol Third Ed*. 2009;4(12):41–
704 58.

705 25. Juergens S, Maune C, Kezze F, Mohr T, Scheuer K, Mallmann P. A randomized,
706 controlled study comparing the cosmetic outcome of a new wound closure device with
707 Prolene suture closing caesarean wounds. *Int Wound J*. 2011;8(4):329–35.

708 26. Cromi A, Ghezzi F, Gottardi A, Cherubino M, Uccella S, Valdatta L. Cosmetic
709 outcomes of various skin closure methods following cesarean delivery: a randomized
710 trial. *Am J Obstet Gynecol* [Internet]. 2010;203(1):36.e1-36.e8. Available from:
711 <http://dx.doi.org/10.1016/j.ajog.2010.02.001>

712 27. Elmaraghy AM, Hashad ANE din, Mohammed MK, Ch AMBB, Maaty AM. Skin
713 closure at cesarean, glue vs Subcuticular sutures : a randomized clinical trial.
714 *GinPolMedProject*. 2021;3(61):1–9.

28. Abdus-Salam RA, Bello FA, Olayemi O. A randomized study comparing skin staples with subcuticular sutures for wound closure at caesarean section in black-skinned women. *ISRN Obstet Gynecol*. 2014;1–9.
29. Draaijers LJ, Tempelman FRH, Botman YAM, Tuinebreijer WE, Middelkoop E, Kreis RW, et al. The Patient and Observer Scar Assessment Scale: A reliable and feasible tool for scar evaluation. *Plast Reconstr Surg*. 2004;113(7):1960–5.
30. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for Prevention of Surgical Site Infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. *Am J Infect Control*. 1999;27(2).
31. Rahman H, Khalda E. Adhesive Glue vs Subcuticular Sutures for Cesarean Section Skin Closure: A Double Blind Randomized Controlled Trial. *Eurasian J Med Oncol*. 2022;5(4):332–40.
32. Gennari R, Rotmensz N, Ballardini B, Scevola S, Perego E, Zanini V, et al. A prospective, randomized, controlled clinical trial of tissue adhesive (2-octylcyanoacrylate) versus standard wound closure in breast surgery. *Surgery*. 2004;136(3):593–9.
33. Rahman H. Adhesive Glue vs Subcuticular Sutures for Cesarean Section Skin Closure: A Double Blind Randomized Controlled Trial. *Eurasian J Med Oncol*. 2022;5(4):332–40.
34. Raja BS, Choudhury AK, Paul S, Gowda AKS, Kalia RB. No Additional Benefits of Tissue Adhesives for Skin Closure in Total Joint Arthroplasty: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *J Arthroplasty*. 2022;37(1):186–202.
35. Gennari R, Rotmensz N, Ballardini B, Scevola S, Perego E, Zanini V, et al. A prospective, randomized, controlled clinical trial of tissue adhesive (2-octylcyanoacrylate) versus standard wound closure in breast surgery. *Surgery* [Internet]. 2004 [cited 2021 Jul 21];136(3):593–9. Available from: <https://www.sciencedirect.com/science/article/pii/S0039606004001229>
36. Halstead LS, Dang T, Elrod M, Convit RJ, Rosen MJ, Woods S. Teleassessment compared with live assessment of pressure ulcers in a wound clinic: a pilot study. *Adv Skin Wound Care*. 2003;16(2):91–6.

PICTURES FROM SAMPLE RANDOM PARTICIPANTS



Figure 1: Appearance of the applied tissue adhesive on the skin after day 1 of surgery



Figure 2: Appearance of the skin after the application of subcuticular stitches one day after surgery



Figure 3: Appearance of the skin at 6 weeks after surgery in the tissue adhesive patient



Figure 4: Appearance of the skin of the same patient after 6 weeks in the subcuticular sutured patient