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Research paper

Safety and Performance of FILASILK^{TM} Silk Surgical Suture in Real-World Surgical Practice: A Retrospective Observational Study

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Abstract

Background
Silk remains one of the oldest and most versatile suture materials used in surgery. Despite advances in synthetic sutures, the clinical utility of natural non-absorbable silk remains relevant, particularly with modern processing enhancements.
Objective
This study aimed to evaluate the safety and performance of Filasilk^{TM} (Meril Endo Surgery Pvt Ltd) sutures across various surgical specialties in a real-world clinical setting.
Methods
This was a retrospective, multi-centre, observational study conducted at three surgical centres in India between December 2018 and April 2023. A total of 163 patients who underwent soft tissue approximation or ligation procedures using the investigational silk suture were included. Primary outcomes included wound complications within one week, while secondary outcomes assessed complications and healing up to three months postoperatively.
Results
Of the 163 patients analysed, the mean age was 52.09±16.21 years, and males constituted 63.19% of the cohort. The most common procedures involved general, ophthalmic, and plastic surgeries. Wound dehiscence was noted in 4.29% of patients at one week, reducing to 3.07% at three months. Wound infection occurred in 1.84% of patients at one week, with no cases persisting at three months. Suture erosion (1.23%), hematoma (3.07%), and seroma (0.61%) were infrequent. Procedural complications such as breakage or inaccurate placement were rare (<2%). The suture demonstrated excellent biocompatibility, knot security, and handling across varied surgical contexts.
Conclusion
FilasilkTM sutures remain a clinically viable and environmentally sustainable alternative to synthetic materials. With low complication rates, favourable handling characteristics, and broad applicability, silk sutures continue to play a valuable role in modern surgical care.

Keywords: *Natural silk suture; non-absorbable sutures; Wound dehiscence; Surgical complications.*

1. Introduction

The choice of suture material is a critical determinant of surgical success, influencing wound healing dynamics, tissue compatibility, infection risk, and cosmetic outcomes [1]. Among the various materials developed for wound closure, silk remains one of the oldest and most reliable natural suture materials, with a longstanding track record in historical and modern surgical practice [2]. Silk is classified as a natural, multifilament, non-absorbable suture, primarily composed of fibroin protein derived from Bombyx mori cocoons. Its unique combination of tensile strength, pliability, knot security, and ease of handling has rendered it a preferred choice in delicate procedures such as ophthalmic, neurosurgical, and cardiovascular operations [3]. Natural silk sutures continue to demonstrate clinical relevance despite the surge in synthetic suture alternatives valued for their consistent degradation profiles and resistance to microbial colonisation. They are beneficial in cases where prolonged tensile strength and precise tissue approximation are required, and the biological response to natural materials is favourable. Advances in silk processing, such as degumming, waxing, and coating with antimicrobial agents, have further improved their performance and biocompatibility, addressing past concerns about microbial susceptibility and inflammatory responses [4]. Recent comparative studies have shown that silk sutures perform on par with, and in some cases, are superior to, synthetic materials in terms of wound healing and patient outcomes. For example, silk has lower dehiscence rates and better tissue reaction profiles than metallic staples or polyamide alternatives in controlled surgical settings [5].

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Moreover, the recent global emphasis on sustainability and biodegradable medical materials has reignited interest in silk sutures for their clinical efficacy and environmental advantages over petroleum-based synthetics [6]. Silk, which is biodegradable outside the human body, requires significantly less energy input in production compared to polymers such as polypropylene or polyester. Research demonstrates silk has a lower environmental impact because it produces less carbon emissions, uses minimal petrochemical resources, and breaks down naturally in soil without toxic byproducts [4,7]. Studies indicate that silk processing requires fewer chemical treatments, resulting in better environmental sustainability [7]. Silk maintains its importance in eco-friendly surgical procedures due to its environmentally friendly characteristics, which align with the growing trend toward sustainable medical products [7]. Through a synthesis of current literature and clinical evidence, this study aims to reaffirm the relevance of FilasilkTM (Meril Endo Surgery Pvt Ltd) sutures in modern surgical care and explore their potential in advancing sustainable and patient-friendly wound closure solutions.

2. Methodology

2.1 Study Design

This retrospective, multi-centre, observational study evaluated the safety and performance of a natural non-absorbable silk surgical suture in real-world clinical settings. The study was conducted at three independent surgical centers in India between December 2018 and April 2023, with a standardized follow-up period of three months post-surgery for each patient. The study adhered to international ethical and regulatory standards, including the Declaration of Helsinki, ICH-GCP (E6 R3), and ISO 14155:2020. Patients were eligible for inclusion if they had undergone soft tissue approximation and/or ligation procedures, such as those in general surgery, ophthalmic surgery, or plastic surgery, and were treated with the investigational silk suture. Only patients with complete clinical records covering the index procedure and the follow-up period were included.

2.2 Study Device

The study device evaluated was a natural non-absorbable silk surgical suture composed of fibroin, a protein derived from the domesticated silkworm Bombyx mori. The suture is a braided, sterile, multifilament strand, available in both dyed (with logwood extract) and undyed formats, and coated with beeswax to enhance handling and reduce tissue drag. It is manufactured to comply with the United States Pharmacopoeia (USP) standards and the European Pharmacopeia (EP) for non-absorbable surgical sutures. The device is intended for general soft tissue approximation and ligation, including specialised applications such as ophthalmic surgeries. Mechanical and biocompatibility tests, including tensile strength, knot pull, needle attachment, sterility, cytotoxicity, and skin sensitisation, confirmed the suture's safety, strength, and tissue compatibility, making it suitable for a broad range of surgical procedures requiring durable wound support. (Figure 01)

Fig. 1: Packaging and configuration of FILASILK™ 3-0 (2 metric) non-absorbable silk surgical suture.

2.3 Study Outcome

The primary outcome of the study was the incidence of wound complications within one week following surgery, defined as a composite of wound dehiscence (complete wound separation requiring reoperation) and wound infection (characterised by purulent discharge, erythema, warmth, or tenderness at the wound site). Secondary outcomes included the rate of wound dehiscence and infection up to three months postoperatively, closure time (measured from placement of the first to the final suture), stitch sinus formation (indicative of chronic suture-related inflammation), and a range of suture-related complications such as erosion, hypersensitivity, hematoma, seroma, and bleeding. Additionally, healing time, defined as the duration between surgery and suture removal, was recorded.

2.4 Sample Size

The sample size for the study was determined based on previously reported wound complication rates associated with surgical sutures. Literature indicated an expected wound complication rate of approximately 10.74% within the first postoperative week. Using this estimate, a confidence level of 95%, a power of 84%, and a confidence interval (CI) half-width of 5.88%, the minimum required sample size was calculated to be 130 patients, employing the Wilson method for confidence interval estimation. To strengthen the robustness of the analysis and account for potential missing or unusable data, the study ultimately included and analysed 163 patients who met all eligibility criteria and had complete follow-up information.

2.5 Statistical Plan

All statistical analyses were performed on the data obtained from enrolled participants. Continuous variables are summarised as mean ± standard deviation (SD), and categorical variables are presented as frequency and corresponding percentages. Statistical analysis was conducted using R software (version 4.3.2 or higher).

2.6 Ethical Approval

Before the study, ethical approval was obtained.

3. Results

3.1 Demographics, Baseline Examination, and Diagnosis

The study population comprised 163 patients with a mean age of 52.09 ± 16.21 years. Age distribution revealed that the majority of participants were between 48–68 years (n=90; 55.21%), followed by 27–47 years (n=37; 22.70%), 69–80 years (n=21; 12.88%), and 6–26 years (n=15; 9.20%). Males predominated the sample (n=103; 63.19%), while females constituted 36.81% (n=60). Baseline clinical parameters showed a mean heart rate of 82.44 ± 11.26 bpm, average height of 164 ± 45.11 cm, and mean weight of 64 ± 21.83 kg. The mean pre-systolic and diastolic blood pressures were 129 ± 15.02 mmHg and 77 ± 9.76 mmHg, respectively. Regarding diagnoses, the most common condition was calculus/calculi (n=46; 28.22%), followed by deep or linear lacerated wounds (n=38; 23.31%) and glaucoma/cataract/pterygium (n=30; 18.40%). Other less frequent conditions included leg-related diseases such as popliteal atherosclerosis (n=8; 4.91%), anus-related diseases (n=9; 5.52%). (Table 1)

Table 1: Demographics, Baseline Examination, and Diagnosis

Variables	Frequency (%)
Age Distribution (years)	15 (9.20)
6 – 26	37 (22.70)
27 – 47	90 (55.21)
48 – 68	21 (12.88)
69 – 80	52.09±16.21
Mean Age	
Gender	103 (63.19)
Male	60 (36.81)
Female	
Baseline Examination	82.44±11.26
Heart Rate (bpm)	164±45.11
Height (cm)	64±21.83
Weight (kg)	129±15.02
Pre-Systolic Blood Pressure (mmHg)	77±9.76
Pre-Diastolic Blood Pressure (mmHg)	
Diagnosis	46 (28.22)
Calculus/Calculi	30 (18.40)
Glaucoma/Cataract/Pterygium	38 (23.31)
Deep/Linear lacerated wound	2 (1.23)
Corrosive Oesophageal Stricture	2 (1.23)
Tongue Related	1 (0.61)
Rupture ectopic pregnancy	3 (1.84)
Abdominal Pain	8 (4.91)
Leg-related Disease/ Popliteal Atherosclerosis	9 (5.52)
Anus-related Disease	2 (1.23)
Carcinoma	1 (0.61)
Hematemesis	1 (0.61)
Hemorrhage	1 (0.61)
Bilateral Orchidectomy	1 (0.61)
S/P Diversion Ileostomy	2 (1.23)
Small Bowel Obstruction + Mesenteric Cyst/ Multiple Ovarian Cyst	1 (0.61)

Pyelonephritis	2 (1.23)
Exploratory laparotomy	1 (0.61)
Lungs	1 (0.61)
Vesicourachal diverticulum	1 (0.61)
TURP	1 (0.61)
BPH with UTI	1 (0.61)
Choledocholithiasis	2 (1.23)
PFUDD/Urethral Stricture	1 (0.61)
Multiple Fibroid Uterus	1 (0.61)
Appendicitis	1 (0.61)
Post-umbilical hernioplasty sepsis	1 (0.61)
Pleural Effusion	1 (0.61)
Wedge Fracture	1 (0.61)
Severe Gastritis	

3.2 Site of Application

Among the 163 patients, the most common site of application was associated with linear or deep lacerated wounds, including lateral and medial canthus regions (n=38; 23.31%), followed by corneal/scleral and conjunctival involvement (n=30; 18.40%), and abdominal or gall bladder-related procedures (n=12; 7.36%). Chronic kidney disease-related interventions accounted for 21 cases (12.88%). Other less frequent application sites included renal and pelvic regions (n=8; 4.91%), and rectal involvement (n=4; 2.45%). A small number of patients had interventions involving the thorax/chest (n=2; 1.23%), urethra (n=2; 1.23%), left lower limb (n=2; 1.23%), uterus and upper ureter (n=2; 1.23%), and sigmoid colon or colon (n=2; 1.23%). Sites with single instances (n=1; 0.61% each) included the pancreas, brain, tongue, duodenum, knee, ovaries, perineum, femoral vein, and lower part of the neck.

Table 2: Site of Application

Variables	Frequency (%)
Site of Application	12 (7.36)
Abdomen, gall bladder	30 (18.40)
Corneo/Scleral & Conjunctiva/ Conjunctiva	38 (23.31)
Linear/Deep lacerated wound/linear lateral medial canthus	21 (12.88)
Chronic kidney disease	1 (0.61)
Left-sided tubal rupture with peritoneum	2 (1.23)
Thorax/ Chest, Thorax	1 (0.61)
Perineal	1 (0.61)
Large internal piles	3 (1.84)
Right PCNL/ Right PCNL + left URS + Bilateral DJ Stenting/ PCNL TRACT	1 (0.61)
Upper GI Endoscopy + NJ tube insertion	2 (1.23)
Right upper urethral calculus/ Urethra	1 (0.61)
Rectum	2 (1.23)
Knee	1 (0.61)
Situ	1 (0.61)
Lungs	1 (0.61)
Left Lower Limb	1 (0.61)
Ovaries	1 (0.61)
Both	2 (1.23)
Left	4 (2.45)
Patient flank area/ Right Flank	1 (0.61)
the lower part of the neck	1 (0.61)
Rectum	1 (0.61)
Femoral Vein	1 (0.61)
Appendicitis	1 (0.61)
L3 Vertebra	1 (0.61)
Right Percutaneous	4 (2.45)
Left Ureteric Calculus / Right Ureteric Calculus	1 (0.61)
& Right Upper Ureteric Calculus/ Uterus	3 (1.84)
Duodenum	1 (0.61)
Tongue/ Ca Right Tongue with Skip Lesion Right Lower Alveolus	1 (0.61)
Anus	2 (1.23)
Pancreas	1 (0.61)
Sigmoid Colon/Colon	1 (0.61)
Lower Limb	1 (0.61)
Left Tibia	1 (0.61)
Brain & Right P-O	8 (4.91)
Bilateral Orchidectomy	
Right Renal Calculus with Left Mid Ureteric Calculus with Left Ureteric Stricture/ Right Renal Pelvic Calculus/ Right Renal Pelvic/ Renal/ Renal Calculus	

3.3 Type of Procedure, Tissue, and Method of Suturing

Out of the 163 surgical procedures analysed, the majority were elective (n=123; 75.46%), while emergency procedures accounted for 40 cases (24.54%). Regarding the type of tissue involved, muscle was the most frequently sutured tissue (n=30; 18.40%), followed by soft tissue (n=24; 14.72%) and subcuticular layers (n=11; 6.75%). Other tissue types included percutaneous (n=4; 2.45%), bone (n=2; 1.23%), and isolated cases involving tendon, intestine, subcutaneous tissue, and veins (each n=1; 0.61%). Regarding suturing techniques, the simple interrupted suture was predominantly used (n=65; 39.88%), followed by continuous sutures (n=10; 6.13%). Less frequently applied methods included interrupted sutures, minor suturing, and baseball suture (each n=1; 0.61%). (Table 3)

Table 3: Type of Procedure, Tissue and Method of Suturing

Variables	Frequency (%)
Type of Procedure	123 (75.46)
Elective	40 (24.54)
Emergency	
Type of tissue	30 (18.40)
Muscle	1 (0.61)
Tendon	11 (6.75)
Subcuticular	4 (2.45)
Percutaneous	2 (1.23)
Bone	24 (14.72)
Soft Tissue	1 (0.61)
Intestine	1 (0.61)
Sub Cutaneous	1 (0.61)
Veins	
Methods of Suturing	65 (39.88)
Simple Interrupted suture	10 (6.13)
Continuous suture	0 (0.00)
Double diabolo suture	1 (0.61)
Interrupted sutures	1 (0.61)
Minor suturing	1 (0.61)
Baseball Suture	

3.4 Type of Surgery

General surgical procedures were the most frequently performed among the various surgical specialties, with appendicitis-related surgeries accounting for 61 cases (37.42%). Other notable general surgery procedures included nephrostomy/nephrotomy with stenting (n=18; 11.04%), general laparotomies (n=3; 1.84%), and cholecystectomy (n=3; 1.84%). Less frequent interventions included cystoscopy (n=3; 1.84%), ileostomy (n=3; 1.84%), jejunostomy (n=3; 1.84%), and laparoscopic surgeries (n=2; 1.23%). Rare cases (each n=1; 0.61%) involved nephrolithotomy, decompressive craniotomy, hemiglossectomy with mandibulectomy, and incision and drainage. Plastic surgery cases were minimal, with only one case each (0.61%) of cleft lip repair, scar excision, skin grafting, and wound debridement. In gynaecology, both caesarean section and ruptured ectopic pregnancy were reported in one case each (0.61%). Ophthalmic surgeries were relatively common, with conjunctival pterygium surgeries in 9 patients (5.52%) and ophthalmic minor procedures in 41 patients (25.15%). Paediatric surgical interventions, primarily laceration repairs, accounted for 5 cases (3.07%). (Table 4)

Table 4: Type of Surgery

Variables	Frequency (%)
General Surgery	7 (4.29)
Laparoscopy	0 (0.00)
Hernia	1 (0.61)
Appendicitis	61 (37.42)
Others	5 (3.07)
Fistula In ANO/ Fistulectomy/ Sphincterotomy/ Prostate Malignancy	3 (1.84)
Hemorrhoidectomy/ hemithyroidectomy, isthmusectomy	18 (11.04)
Cystoscopy/ Nephrostomy/ Nephrotomy + Stenting	3 (1.84)
Endoscopy	2 (1.23)
Left above-knee amputation/ Phlebotomy	6 (3.68)
PCNL+ DJ stenting	1 (0.61)
Laparoscopic	2 (1.23)
Perennial end-to-end anastomotic urethroplasty	3 (1.84)
Jejunostomy under GA/ Infrasuptical reduction with Adhesiolysis under GA	3 (1.84)
Nephrolithotomy	1 (0.61)
Lithotomy	1 (0.61)
Spine Surgery	2 (1.23)
Ileostomy	3 (1.84)
Cholecystectomy	3 (1.84)
Laparatomy	1 (0.61)
Jejunostomy	1 (0.61)
Incision & Drainage	1 (0.61)
Decompressive Craniotomy	1 (0.61)
Hemiglossectomy Mandibulectomy	1 (0.61)
Right Renal Calyceus with Left Mid Ureteric Calculus with Left Ureteric Stricture	
Plastic surgery	1 (0.61)
Cleft lip	0 (0.00)
Excision of scars	1 (0.61)
Skin graft	1 (0.61)
Re-exploration+abscess drainage+wounded bridement	1 (0.61)
Midline incision&mesh removed and debridement	
Gynaecology	1 (0.61)
Caesarean section	1 (0.61)
Rupture ectopic pregnancy	
Ophthalmic surgery	9 (5.52)
Conjunctival Pterygium Surgery	41 (25.15)
Ophthalmic minor surgery	
Paediatrics	5 (3.07)
Paediatric lacerations	

3.5 Procedural Complication

Among the 163 patients evaluated, procedural complications were relatively infrequent. Difficulty in suturing, breakage of suture, and failure to place the suture accurately were each reported in 2 cases (1.23%). Misplacement of suture was observed in only 1 case (0.61%). (Table 5)

Table 5: Procedural Complication

Variables	Frequency (%)
Difficulty in suturing	2 (1.23)
Breakage of the suture	2 (1.23)
Failed to place the suture accurately	2 (1.23)
Misplacement of suture	1 (0.61)

3.6 Clinical Outcomes Through 3-Month follow-up

During the 3-month follow-up period, wound dehiscence was reported in 7 patients (4.29%) at 1 week and persisted in 5 patients (3.07%) at 3 months. Wound infection was observed in 1 patient (0.61%) immediately post-procedure and increased to 3 cases (1.84%) at 1 week, resolving by the 3-month mark. Suture erosion appeared in 2 patients (1.23%) at 3 months, while 38 patients (23.31%) required suture removal by the end of week one. Bleeding and hematoma were each reported in 3 patients (1.84%) post-procedure, with follow-up showing 4 cases (2.45%) of bleeding and 5 cases (3.07%) of hematoma at 3 months. Seroma was reported in 1 case (0.61%) at 3 months. Rare but notable findings included vesicourachal diverticulum (0.61%), infection with pus (0.61%), and a single case (0.61%) requiring mesh removal and debridement under anaesthesia. (Table 6)

Table 6: Clinical Outcomes through 3-month follow-up

Events, n (%)	Postprocedure (n=163)	Procedural complications (n=163)	1 week FU (n=163)	3-month FU (n=163)
Wound Dehiscence	0	0	7 (4.29)	5 (3.07)
Wound Infection	1 (0.61)	0	3 (1.84)	0
Suture Erosion	0	0	0	2 (1.23)
Sutures Removed	0	0	38 (23.31)	0
Bleeding	3 (1.84)	0	0	4 (2.45)
Hematoma	3 (1.84)	0	0	5 (3.07)
Seroma	0	0	0	1 (0.61)
Vesicourachal Diverticulum	0	0	1 (0.61)	0
Infection Wound, Pus Collection	0	0	1 (0.61)	0
Midline incision with Mesh Removed And Debridement of Part Done Under Anaesthesia	0	0	1 (0.61)	0
Difficulty in Suturing	0	2 (1.23)	0	0
Breakage of Suture	0	2 (1.23)	0	0
Failed to Place the Suture Accurately	0	2 (1.23)	0	0
Misplacement of Suture	0	1 (0.61)	0	0

4. Discussion

This multi-centre observational study reinforces the continued clinical relevance of FilasilkTM (Meril Endo Surgery Pvt Ltd), a natural non-absorbable silk sutures in modern surgical practice. Despite the widespread adoption of synthetic alternatives, the observed outcomes from 163 patients suggest that silk remains a safe and effective choice across a broad spectrum of surgical indications, including general, ophthalmic, plastic, and gynaecological procedures.

The most notable finding of this study was the low rate of wound dehiscence (4.29% at 1 week, reducing to 3.07% at 3 months), which aligns with or improves upon rates reported for synthetic sutures in similar settings. Previous literature comparing natural and synthetic sutures has shown that silk offers superior knot security and favourable tissue handling characteristics, which are crucial in minimising wound tension and promoting optimal healing conditions [8, 9]. The wound infection rate (1.84% at 1 week) also falls within acceptable clinical limits and compares favorably with polyamide and polyester-based sutures, which have reported rates ranging from 3–6% in clean-contaminated surgeries [10].

Suture erosion, hematoma, and seroma were rare complications, affecting <3% of patients, indicating good biocompatibility. The low rates of procedural complications, such as breakage or inaccurate placement, may reflect both the silk suture's inherent mechanical properties and the surgeon's skill. Modern processing techniques, such as beeswax coating and enhanced sterilisation protocols, likely reduce tissue drag and microbial colonisation, mitigating some of the historical concerns surrounding silk [11 12].

The advantages of silk sutures are multifactorial. Mechanically, silk exhibits excellent pliability and knot security, which were confirmed during this study through the predominant use of simple interrupted sutures in 39.88% of cases. Silk's minimal capillarity and reduced inflammatory response due to modern degumming and coating techniques render it suitable even in ophthalmic and delicate tissue applications [13].

Although synthetic monofilament sutures often claim lower infection rates due to reduced bacterial wicking, studies have shown that braided sutures like silk, when appropriately coated and sterilised, do not significantly elevate infection risk in clean surgical environments [14]. Moreover, the present study's real-world setting across three independent centres provides robust external validity, supporting the generalizability of the findings.

Furthermore, prior comparative research has demonstrated that silk sutures perform on par with synthetic alternatives regarding tensile strength and healing profile, particularly in soft tissue approximation [15]. The present study adds to this body of evidence by documenting favourable clinical outcomes across various anatomical sites and surgical specialties.

Future research should be performed using randomised controlled trials to assess the silk sutures against synthetic materials, particularly polyamide and polypropylene, by evaluating the clinical endpoints such as infection rates, healing time, and cosmetic outcomes. Earlier studies have reported that silk demonstrates comparable tensile strength and knot security to polyamide sutures under both in vivo and in vitro conditions [15], while clinical studies have highlighted the influence of suture material and coatings on surgical site infection rates [16]. Although preclinical and small-scale comparative studies have reported encouraging results for silk sutures [5], large-scale clinical trials in real-world surgical environments remain inadequate. Furthermore, prospective studies with an extended follow-up period should evaluate the chronic complications that may not emerge during short-term observation, such as stitch sinus formation, delayed inflammation, and suture extrusion. Research investigations would enhance our understanding of natural silk sutures by providing detailed information about their long-term safety, clinical performance, and sustainability profile.

5. Conclusion

This multi-centre observational study demonstrates that natural non-absorbable silk surgical sutures offer excellent clinical utility across various surgical specialities from general surgery, ophthalmic, gynaecological, and plastic surgery. With low complication rates such as wound dehiscence, infection, and erosion, and favourable handling properties, silk sutures have proven to be both safe and effective. Modern advancements in suture processing, including waxing and sterilisation, have further enhanced their biocompatibility and reduced historical concerns about microbial colonisation.

Strength

This study benefits from a real-world, multi-centre design, enhancing the generalizability of findings across diverse surgical environments such as general, ophthalmic, and plastic surgery, underscoring the versatility of silk sutures. The analysis of 163 patients with complete follow-up strengthens the validity of the clinical outcomes.

Limitation

The present study is retrospective and is susceptible to selection bias and limitations in data completeness. The absence of a comparator group using synthetic sutures limits direct performance comparisons. The follow-up period of three months may not capture long-term complications such as chronic suture-related inflammation or delayed wound issues.

Future Directions

To address the current study's limitations, particularly the absence of a comparator group, future research should aim to include synthetic suture materials as active comparators. Prospective studies or randomised controlled trials comparing silk with commonly used synthetic sutures (e.g., polypropylene, polyglycolic acid) would offer more definitive insights into their relative performance in terms of wound healing, infection rates, and long-term outcomes. Additionally, the use of synthetic control arms derived from institutional databases or national registries may serve as a viable alternative in settings where randomized designs are not feasible.

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