Surgical Site Infection Following Nail Bed Repair with or without Nail Plate Coverage: A Randomized Clinical Trial

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Abstract

Background: The fingernail plays a vital role in protecting the dorsal fingertip and contributes significantly to hand function and aesthetics. Fingertip injuries represent approximately two-thirds of paediatric hand trauma, with nail bed injuries accounting for 15%–24% of cases. Standard management often involves nail plate removal, nail bed repair, and nail replacement to protect the repair site, reduce infection risk, ease dressing changes, and prevent adhesions. In the absence of the original nail, substitutes such as silver foil or acrylic nails are commonly used.

Objective: To compare the incidence of surgical site infection in nail bed repairs performed with and without nail plate coverage.

Methods: A randomized clinical trial was conducted in the Plastic Surgery Department at Patel Hospital between March 2024 and February 2025. A total of 152 patients with nail bed lacerations were enrolled and randomly assigned to either receive nail plate replacement (foil substitute was used when nail plate was not available) (n=76) or undergo repair without nail bed coverage (n=76). Surgical site infections were monitored postoperatively in both groups.

Results: Surgical site infections occurred in 3.9% (3/76) of patients in the nail coverage group and 2.6% (2/76) of patients in the no-coverage group, with no statistically significant difference. Multivariate logistic regression confirmed that nail coverage was not an independent predictor of infection. Injuries due to road traffic accidents showed a trend toward higher odds of infection (aOR: 15.88, p=0.063), while patients aged 19–35 years demonstrated a significantly lower risk (aOR: 0.037, p=0.031).

Conclusion: Nail bed coverage following repair does not significantly reduce the risk of surgical site infection. Omitting nail plate replacement is a safe and cost-effective alternative, simplifying postoperative care without increasing infection risk.

Clinical Trial Registration no.: NCT06949189

Keywords: *Finger injuries, fingertip trauma, nailbed injuries, nailbed coverage, laceration, infection, plastic surgery.*

INTRODUCTION

The fingernail serves as a protective barrier for the dorsal fingertip while also enhancing its aesthetic appeal [1, 2]. It plays a crucial role in fine motor functions such as precise picking and pinching by improving tactile sensitivity and providing structural support to the fingertip's soft tissue [1, 3-6]. Additionally, vascular sinuses within the nail bed contribute to fingertip circulation regulation [1, 7].

Fingertip injuries account for approximately two-thirds of paediatric hand injuries [8], with nail bed injuries comprising 15% to 24% of these cases [9-13]. These injuries frequently occur due to crush mechanisms, such as a fingertip being caught in a closing door, leading to nail plate displacement and soft tissue damage to the nail bed [11, 14]. In the United Kingdom, 96% of surgeons routinely remove the nail plate, repair the nail bed laceration with sutures, and then reposition the nail plate onto the nail bed [14, 15]. The rationale for repositioning includes protecting the repair, reducing infection risk, minimising pain during dressing changes, and preventing adhesions by supporting the nail fold [2, 14]. When the autologous nail is unavailable due to fragmentation or contamination, alternatives such as silver foil or acrylic nail replacements have been suggested to prevent adhesions to the germinal matrix and improve wound healing [16-18].

Despite its widespread use, the benefit of nail plate repositioning remains uncertain. In 2012, Miranda *et al*. reported significantly higher complication rates—including infections—in cases where the nail plate was replaced or covered with a foil compared to those where the nail was discarded [9]. In contrast, a 2023 Cochrane review on nail bed injuries, as noted by Jain *et al*., found no randomized trials evaluating different methods of nail bed repair and concluded that there was insufficient evidence to guide key treatment decisions for fingertip injuries in children [14]. To address this gap, Jain *et al*. conducted a multicentre randomized controlled trial involving 451 patients; they found no statistically significant difference in early infection rates (by day 7) or final cosmetic outcomes between patients whose nails were replaced and those whose nails were discarded after nail bed repair [14]. The conflicting evidence has resulted in clinical equipoise regarding the necessity of nail plate repositioning.

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This study aims to address this gap by comparing surgical site infection rates in patients undergoing nail bed repair with and without nail plate repositioning. By providing clearer evidence on infection risk, the study seeks to guide clinical decision-making and optimise surgical management for nail bed injuries.

MATERIALS AND METHODS

This randomized clinical trial was conducted in the Plastic Surgery Department at Patel Hospital between March 2024 and February 2025 (Clinical Trial Registration No: NCT06949189). The trial was commenced after obtaining ethical approval from the institutional ethics committee (IRB No: PH/IRB/2023/042). Patients of all age groups and genders presenting to the emergency or outpatient department within 48 hours of injury were screened. Inclusion criteria included nail bed injury limited to a single finger, without open fractures or the need for bony fixation. Exclusion criteria were pre-existing nail deformities, nail bed loss requiring reconstruction, infected wounds, distal phalanx fractures requiring fixation, amputations, multiple finger involvement, known allergies to prescribed medications, or underlying nail diseases. Written informed consent was obtained from all participants or their guardians in the case of minors.

The sample size was calculated using the WHO sample size calculator for hypothesis testing of two population proportions (one-sided test). Based on a 5% significance level, 80% power, a population proportion of 0.0 (9) for the group with no nail bed coverage, and a population proportion of 0.078 (9) for the group with nail bed coverage, a total sample size of 152 patients was determined, with 76 patients in each study arm. A non-probability consecutive sampling technique was used for patient enrollment. Patients were randomized into two groups (Group A and Group B) using sealed opaque envelopes prepared in a 1:1 ratio (76 in each group), ensuring allocation concealment. **Fig. (1)** displays the consort diagram given details of total patients enrolled and analysed. The primary investigator conducted randomization by drawing an envelope at the time of patient presentation, ensuring allocation concealment by preventing prior knowledge of the assigned procedure. The operating surgeon was informed of the allocation only after the envelope was opened, maintaining blinding in the randomization process.

Data collection and procedures were performed by a plastic surgery resident with a minimum of one year of training. Data collection was conducted in three phases. The first phase involved screening patients based on

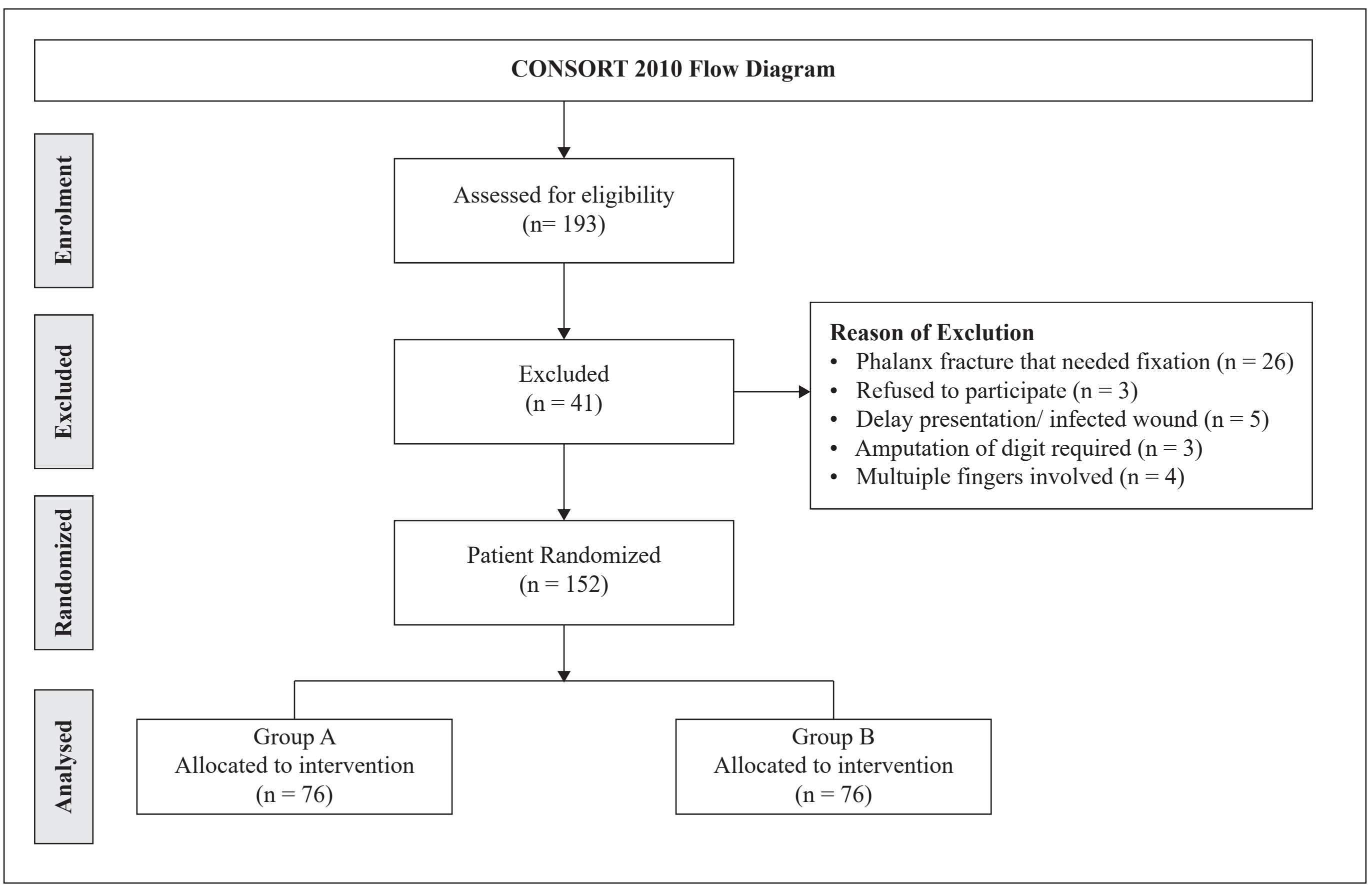

Fig. (1): Consort Diagram.

the inclusion and exclusion criteria. When eligible, demographic and intraoperative details were recorded. The final phase of data collection was completed postoperatively in the outpatient department (OPD) or Plastic Surgery Operating Room by either a plastic surgery resident or consultant, through face-to-face clinical evaluations. Each patient was followed for a minimum of one month after surgery.

Postoperative care included application of Polyfax ointment, Chlorhexidine acetate gauzes (Bactigras), and surgical gauze dressings. A seven-day course of oral medications was prescribed, including Co-amoxiclav 625 mg three times daily, Paracetamol 1 gm three times daily, and Ibuprofen 200 mg twice daily for adults (aged ≥10 years). Pediatric doses of Syrup Co-amoxiclav, Paracetamol, and Ibuprofen were administered for children under 10 years of age.

The first dressing change was performed in the Plastic Surgery Operating Room at 48 hours postoperatively, followed by dressing changes on alternate days by hospital staff or trained family members. Wound assessments were conducted on postoperative days 7th, 12th, and 30th. If the wound appeared clean on day 7, no further dressing was required. In cases where infection was suspected, the wound was managed according to standard medical guidelines.

Surgical site infection (SSI) was diagnosed according to CDC guidelines, requiring at least two of the following criteria within 30 days postoperatively: purulent discharge, pain with a numerical pain scale value of 7 or greater considered positive, swelling, erythema (defined as visible redness extending beyond the distal interphalangeal joint compared to the contralateral finger), and tenderness (characterized by pain upon touch).

Following debridement and suturing of the nail bed, patients in Group A (Nail Bed Coverage) had the fingernail repositioned and secured with a figure-of-eight suture using Prolene before dressing application; in cases where the nail was unavailable due to damage or loss, a foil substitute was used. In contrast, for Group B (No Nail Bed Coverage), the fingernail was discarded after debridement and suturing, and dressing was applied directly.

Statistical analyses were conducted using SPSS version 23. Descriptive statistics were used to summarise the data. Categorical variables such as gender, comorbidities, mechanism of injury, involved digit, and surgical site infection (SSI) were reported as frequencies and percentages. Continuous variables like age were expressed as mean ± standard deviation (SD), and normality was assessed using the Shapiro–Wilk test. Independent t-test was applied to compare numerical variables between two groups and categorical variables were compard using Chi-square test. To identify factors independently associated with surgical site infection, both univariate and multivariate logistic regression analyses were performed. Multivariate modelling was used to adjust for potential confounding variables, including age, comorbidities, and mechanism of injury. For the regression model, the variable "mechanism of injury" was recategorized to ensure statistical stability: road traffic accidents (RTA) and sharp injuries were retained as separate categories, while other mechanisms (trap injuries, fan blade injuries, blunt/bed trauma, and crush/hammer injuries) were combined under a single category labeled "blunt trauma". A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 152 patients with nail bed injuries were included in the study, with 76 patients in each group. The mean age was significantly higher in Group A (16.1 ± 17.4 years) compared to Group B (10.5 ± 12.3 years) ($p = 0.001$). Despite this age difference, other baseline characteristics, including gender distribution, comorbidities, and mechanism of injury, were comparable between the two groups, with no statistically significant differences. The most common mode of injury was trap injury, followed by sharp object trauma, road traffic accidents, and other blunt or crush injuries. Given the similarity in demographic and clinical characteristics apart from age, both groups were well-matched for comparative analysis (**Table 1**).

The incidence of surgical site infection (SSI) was low in both groups, with 6 patients (3.9%) in Group A and 4 patients (2.6%) in Group B developing an infection. However, this difference was not statistically significant ($p = 0.513$) (**Table 2**). **Figs. (2-4)** show representative cases from both groups, illustrating the extent of injury, intraoperative repair, and subsequent nail bed healing during the postoperative period.

Univariate and multivariate logistic regression analyses were performed to identify factors associated with surgical site infection (SSI) following nail bed repair (**Table 3**). In the univariate analysis, patients aged less than 12 years (OR: 0.012, 95% CI: 0.001–0.113, $p <0.001$) and those aged 19–35 years (OR: 0.064, 95% CI: 0.007–0.603, $p=0.016$) had significantly lower odds of developing SSI compared to patients older than 35 years. The presence of diabetes mellitus was also associated with reduced odds of infection (OR: 0.029, 95% CI: 0.007–1.33, $p<0.001$). In contrast, road traffic accidents (RTA) were significantly associated with higher odds of

SSI (OR: 12.4, 95% CI: 2.316–66.693, p=0.003). Nail bed coverage showed no significant association with SSI in univariate analysis (OR: 1.5, 95% CI: 0.406–5.54, p=0.543).

In the multivariate analysis, after adjusting for nail bed coverage, diabetes mellitus, age group, and mechanism of injury, only the 19–35-year age group remained significantly associated with reduced risk of SSI (adjusted OR: 0.037, 95% CI: 0.002–0.745, p=0.031). Nail bed coverage remained non-significant

Table 2: Comparison of surgical site infection among the two study groups.

	Groups	Group A n(%)	Group B n(%)	p-value
Surgical site infection	**yes**	6 (3.9)	4 (2.6)	0.513
	no	70 (41.6)	72 (47.4)	

Table 1: Comparison of patients' demographic and clinical features among the two study groups.

Variables	Groups	Group A n(%)	Group B n(%)	p-value
Age (in years)#	-	16.13 ± 17.4	10.5 ± 12.3	0.001
Gender	**Female**	27 (17.8)	32 (21.1)	0.693
	Male	49 (32.2)	44 (28.9)	
Comorbidities	**None**	65 (42.8)	73 (48.0)	0.091
	DM	6 (3.9)	3 (2.0)	
	HTN	2 (1.3)	0 (0)	
	DM + HTN	3 (2.0)	0 (0)	
Mode of injury	**Trap injury**	42 (27.6)	54 (35.5)	0.063
	RTA	3 (2.0)	7 (4.6)	
	Sharp	15 (9.9)	7 (4.6)	
	Fan blade	3 (2.0)	1 (0.7)	
	Blunt/bed	11 (7.2)	4 (2.6)	
	Crush/hammer	2 (1.3)	3 (2.0)	

#*Age is presented as mean ± SD*

Fig. (2): A 57-year-old male with traumatic injury to the left ring finger. **A–B**: Preoperative views, **C-D**: Immediate postoperative view after nail bed repair and nail plate replacement (Group A). **E**: Day 14 postoperative follow-up. **F**: Day 30 postoperative outcome showing satisfactory healing.

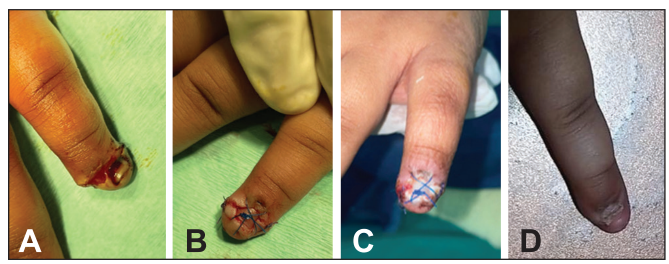

Fig. (3): A pediatric patient with injury to the little finger. **A**: Initial presentation, **B**: Immediate postoperative view after repair and nail plate coverage (Group A), **C**: Day 7 postoperative follow-up and **D**: Day 30 showing healed wound and good nail regrowth.

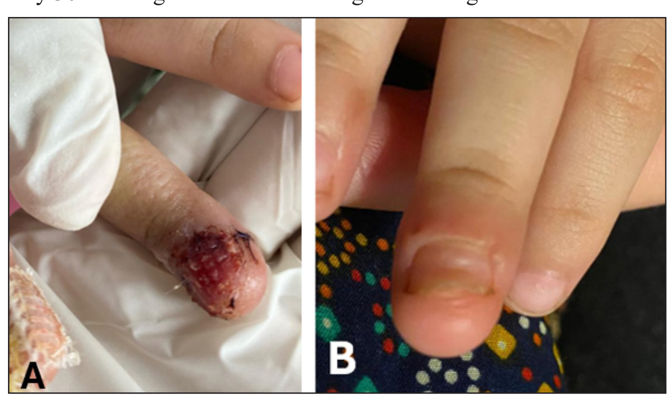

Fig. (4): Healing progression following nail bed repair without nail plate coverage (Group B). **A**: Postoperative day 3 showing a clean wound bed. **B**: At 2 months, demonstrating full nail regrowth and resolution of injury.

Table 3: Univariate and multivariable analysis of factors associated with surgical site infection.

Variables	Univariate		Multivariate	
	OR (95% Cl)	p-value	aOR (95% Cl)	p-value
Nail bed coverage				
Yes	1.5 (0.406-5.54)	0.543	1.4 (0.206-10.73)	0.690
No	Reference category		Reference category	
Comorbidities				
Diabetes Mellitus	0.029 (0.007-1.33)	<0.001	0.113 (0.11-1.128)	0.063
No Diabetes Mellitus	Reference category		Reference category	
Age groups (years)				
Less than 12	0.012 (0.001-0.113)	<0.001	0.068 (0.004-1.163)	0.064
13 to 18	0.129 (0.013-1.258)	0.078	0.199 (0.009-4.514)	0.311
19 to 35	0.064 0.007-0.603)	0.016	0.037 (0.002-0.745)	0.031
Greater than 35	Reference category		Reference category	
Mechanism of injury				
RTA	12.400 (2.316-66.693)	0.003	15.888 (0.863-292.53)	0.063
sharp	4.570 (0.949-22.088)	0.058	2.181 (0.261-18.242)	0.472
Blunt	Reference category		Reference category	

CI: Confidence interval, OR: Odds ratio, aOR: Adjusted odds ratio, RTA: Road traffic injury.
Note: For regression analysis, injury mechanisms were regrouped as RTA, sharp, and blunt (which includes trap, fan blade, blunt/bed, and crush/hammer injuries).

(adjusted OR: 1.4, 95% CI: 0.206–10.73, p=0.690). Notably, injuries due to road traffic accidents were associated with markedly increased odds of SSI (adjusted OR: 15.888), although this did not reach statistical significance (95% CI: 0.863–292.53, p=0.063). This suggests a possible clinical association that may warrant further investigation in a larger sample. The protective effect of diabetes mellitus observed in the univariate analysis was attenuated in the multivariate model (adjusted OR: 0.113, p=0.063). No other age groups or mechanisms of injury were significantly associated with SSI.

DISCUSSION

Our findings demonstrate no significant difference in SSI rates between the two groups, suggesting that nail bed coverage does not impact infection risk. This supports the idea that discarding the fingernail after nail bed repair is a viable option, allowing the decision to be based on other factors such as pain management, cosmetic concerns, and functional recovery rather than infection prevention. The low infection rates in both groups may be attributed to standardised postoperative care, including prophylactic antibiotics and meticulous wound management.

These results align with existing literature, reinforcing the notion that nail bed coverage does not significantly influence infection risk. This conclusion is further supported by our multivariate analysis, which demonstrated that nail bed coverage was not an independent predictor of surgical site infection, even after adjusting for age, comorbidities, and mechanism of injury. The NINJA multicenter randomized clinical trial by Jain *et al*. [14] similarly found no difference in early infection rates or cosmetic outcomes between patients whose fingernails were replaced and those whose fingernails were discarded. The Nail Bed Injury Analysis – Pilot (NINJA-P) study [19] also reported low complication and infection rates, suggesting that meticulous wound care plays a more critical role in infection prevention than nail replacement itself. Inglefield *et al*. [1] found no significant differences in outcomes between nail replacement and non-replacement in pediatric nail bed injuries, reinforcing that both approaches can be effective with proper wound management. Conversely, Miranda *et al.* [9] suggested that nail replacement might increase morbidity due to infection and prolonged healing times. Interestingly, although nail bed coverage was not a significant predictor of SSI, our analysis revealed that road traffic accidents were associated with markedly increased odds of infection, despite not reaching statistical significance. This finding suggests that more severe or contaminated injuries—such as those sustained in RTAs—may inherently carry a higher risk of infection, independent of nail replacement. Shaw *et al*. [20] emphasised that meticulous wound care is the key determinant of infection risk, with their study suggesting that short courses of Co-amoxiclav may help reduce infections. However, Jain *et al*. [14] questioned the routine use of antibiotics, arguing that proper wound care alone may suffice for infection prevention. Another noteworthy finding from our regression analysis was the significantly reduced risk of infection among patients aged 19–35 years. This age group exhibited a protective effect, with statistically significant results, which may be attributed to more efficient tissue healing, stronger immune response, or greater adherence to postoperative care. These results underscore the importance of considering patient age when assessing infection risk and optimising postoperative management strategies.

LIMITATION AND FUTURE DIRECTIONS

While this study provides valuable insights, certain limitations must be acknowledged. The sample size was calculated based on the SSI rate reported in a previously published study, which documented a 0% infection rate in one of the comparison groups [9]. Although this served as a practical reference for estimation, we recognise that assuming a 0.0 infection proportion is statistically limiting and may have led to an underestimation of the required sample size. This limitation should be considered when interpreting the findings, and future studies with larger cohorts are recommended to validate our results. Furthermore, the one-month follow-up period may not capture long-term complications such as nail deformities, functional deficits, or patient satisfaction with cosmetic outcomes. As this was a single-centre study, the generalizability of the findings to broader populations may also be limited.

Additionally, although multivariate adjustments were performed, residual or unmeasured confounding cannot be entirely excluded. Nevertheless, the consistently low infection rates observed in both groups support the consideration that discarding the nail may be a safe and practical alternative to nail replacement in similar clinical settings, potentially simplifying postoperative care and reducing healthcare costs. Patients who developed infections were managed with daily dressings, extended courses of antibiotics, and oral analgesia, with close clinical follow-up to ensure recovery.

Future research should explore long-term functional and cosmetic outcomes, psychological impact, and quality of life following nail bed repair. Although our study did not assess cosmetic appearance or functional recovery, these are important outcomes that directly influence patient satisfaction and quality of life. Future studies should incorporate standardised measures for cosmetic and functional assessment to better guide surgical decision-making. As Sierakowski *et al*. [15] emphasised, surgical decisions should go beyond infection risk and consider patient-centred factors such as functional recovery and aesthetic satisfaction, which remain key determinants of surgical success.

CONCLUSION

Nail bed repair, whether performed with or without nail plate coverage, does not appear to impact surgical site infection rates, reaffirming the importance of standardised postoperative care. Discarding the fingernail is a safe and cost-effective alternative that may simplify recovery without increasing infection risk. Future research should focus on long-term outcomes, including nail aesthetics, functional recovery, and patient satisfaction, to further guide evidence-based clinical decision-making.

ETHICAL APPROVAL

Ethical approval was obtained from the Institutional Ethics Committee of Patel Hospital, Karachi (REF letter No. PH/IRB/2-23/042). All procedures performed in studies involving human participants were following the ethical standards of the institutional and/ or national research committee and the Helsinki Declaration.

CONSENT FOR PUBLICATION

Written informed consent was obtained from all participants or their guardians in the case of minors.

AVAILABILITY OF DATA

The data set may be acquired from the corresponding author upon a reasonable request.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORS' CONTRIBUTION

Dr. Osheen Abbasi: Conceptualisation, study design, surgical procedures, data interpretation, manuscript writing, and critical revision.

Dr. Kashmala Qureshi: Patient recruitment, data collection, literature review, data entry, and critical revision of the manuscript.

Dr. Mazhar Nizam: Senior supervision of clinical work, methodological oversight, and critical review and approval of the final manuscript.

Dr. Zuhera Khan: Intraoperative support, case monitoring, contribution to data interpretation, and critical revision of the manuscript.

Dr. Ghulam Murtaza: Statistical analysis, data interpretation, critical appraisal, and approval of the final manuscript.

Dr. Adila Kakar: data collection

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