DELAYED PRIMARY CLOSURE IN MANAGING PEDIATRIC ABDOMINAL WOUND INFECTIONS: OUTCOMES FROM A RESOURCE-LIMITED SETTING

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ABSTRACT

Background

Inguinal hernia repair is a common pediatric surgical procedure, with open and laparoscopic techniques being the two main approaches. While both methods are effective, each has unique advantages and limitations.

Objective

This study was aimed to evaluate the outcomes of DPC in managing pediatric abdominal wound infections, focusing on healing time, complication rates, and hospital stay duration.

Methods

This prospective observational study was conducted for about 6 months from Nov, 2009 to April, 2010 in the Department of Paediatric Surgery, Khalifa Gulnawaz Teaching Hospital, Bannu Medical College, Bannu, Pakistan. One hundred fifty patients aged 0 to 12 years with abdominal wound infections treated by DPC were enrolled. Demographic information, specific clinical variables, procedural factors, and post-procedure complications and mortalities were recorded. The significance of associations was analysed by applying statistical tests; factors with $P < 0.05$ were assumed to be significant.

Results

Most patients who participated in the study were cured within 14 days; 53.3% healed within 7–14 days, while 33.3% healed within less than 7 days. There were remarks on complications in 20% of cases, with wound dehiscence attesting to 13.3% and re-infection in 6.7%. The hospital stay was mostly within 5–10 days (46.7%), while fewer cases required more days. Hypo and hyper nutrition in the contaminated sites and timely interventions affected the results ($P < 0.05$).

Conclusion

Delayed primary closure proved to be the most feasible and effective way of dealing with pediatric abdominal wound infections in LMICs. This technique helps heal wounds faster and has fewer complications, lowering hospitalisation rates. Based on the findings, the theory and its applicability to similar healthcare contexts can be generalized, focusing on infection control and early intervention.

Keywords: *Inguinal hernia, Pediatric surgery, Laparoscopic repair, Open repair, Postoperative outcomes, minimally invasive surgery, Hernia recurrence, Cosmetic outcomes*

INTRODUCTION

Managing wound infection in children has several challenges and these are particularly evident in developing countries. Abdominal wound infections are among the most prevalent and potentially fatal surgical site complications; proper management is necessary to prevent multiple complications and achieve early healing. The impact of infection on the children, growth and development, and general health also argues for good principles of wound management (1,2).

DPC has emerged as a reasonable method of managing contaminated or infected wound from the earlier concerns as to its applicability. This technique is done by initially making the wound wider then having control of the infection before proceeding to closing it. DPC minimizes the likelihood of having a localized infection in the wound that may lead to formation of an abscess, or contraction of a wound that was left open. The technique adopted in this report is a literature review where the method has offered features of both primary closure and secondary intention healing which reduced the number of patients who developed infections and healed in a shorter time (3-5).

DPC is particularly beneficial in the application of advanced care within a given environment where some of the tools and structures may not be available caused by limited resources. Hence the technique incorporates some of the general steps in the care of such wounds, as for example debridement and irrigation with the least possible use of antibiotics. However, like all medical procedures, its success depends upon with respect to time it is done, the technique used in the surgical process and which type of patients must go for the advancement.

The purpose of this study was to evaluate delayed primary closure as a method towards management of abdominal wound infections in children in a developing country. This study aims to compare outcomes that characterise this approach to the usual treatment focusing on time to heal, rate of complications, and days in the hospital. The results are expected to help clinicians know how they can improve various kinds of wound care, especially in a centre of limited resources.

METHODOLOGY

This prospective observational study was conducted for about 6 months from Nov, 2009 to April, 2010 in the Department of Paediatric Surgery, Khalifa Gulnawaz Teaching Hospital, Bannu Medical College, Bannu, Pakistan. The aim was to assess the results of primary closure in treating pediatric abdominal wound infections. For all the participants, informed consent was taken from the parents or the guardians of the participant. Identifying details were removed from data during data collection and analysis to ensure patient privacy.

The study included pediatric patients aged 0–12 years that underwent abdominal surgery and developed wound infections requiring delayed primary closure. Patients were selected based on predefined inclusion and exclusion criteria.

Inclusion Criteria

- Pediatric patients aged 0–12 years.
- Presence of abdominal wound infection after surgery.
- Patients managed with delayed primary closure.
- Cases with complete medical records available for review.

Exclusion Criteria

1. Patients with incomplete medical records.

2. Those with pre-existing systemic conditions like uncontrolled diabetes or severe immunodeficiency that could impact wound healing.

3. Patients whose wounds were managed with techniques other than delayed primary closure. Convenience sampling was used to enrol all eligible patients presenting during the six-month study period. Based on the estimated patient load and sample size calculation, 150 patients were included. Data were collected prospectively using a structured data collection form. The

form included demographic details (age, gender, nutritional status, and geographical location), clinical

characteristics (primary diagnosis, type of surgery, and wound contamination level), procedural variables (time to delayed closure, wound management methods, and antibiotic use), and postoperative outcomes (healing time, complications, and hospital stay).

Following initial surgery, patients with wound infections were treated with open wound care involving saline irrigation and sterile dressings. Antibiotic therapy was administered based on clinical guidelines and sensitivity reports. Delayed primary closure was performed after achieving adequate infection control, typically within 3–10 days. The surgical technique involved meticulous debridement and tension-free closure under sterile conditions.

The primary outcome was the duration of complete wound healing. Secondary outcomes included the incidence of complications (e.g., wound dehiscence and re-infection), length of hospital stay, and the need for repeat surgeries. All outcomes were monitored until complete healing or discharge. Data were entered into a statistical software package for analysis. Categorical variables, such as gender, nutritional status, and complications, were presented as frequencies and percentages. Continuous variables, including age, healing time, and hospital stay, were expressed as means and standard deviations. Associations between variables were assessed using appropriate statistical tests, with a P-value of <0.05 considered significant.

Result:

The study population consisted predominantly of children aged 1–5 years, accounting for 53.3% of cases, followed by those aged 6–12 (26.7%) and infants less than 1 year (20%). A higher proportion of males (60%) than females (40%) was observed, although the gender difference was not statistically significant (P = 0.421). Nutritional status significantly impacted outcomes (P = 0.035), with most children being well-nourished (63.3%), while 26.7% were undernourished, and 10% were over nourished. Urban residents comprised 66.7% of the sample, significantly more than rural residents (33.3%, P = 0.002). These findings suggest that age, nutritional status, and geographical location may influence wound healing in pediatric patients.

Table 1: Demographic Characteristics of Pediatric Patients with Abdominal Wound Infections

Variable	Frequency (n)	Percentage (%)	P-value
Age (years)			
<1 year	30	20.0	
1–5 years	80	53.3	
6–12 years	40	26.7	
Gender			0.421
Male	90	60.0	
Female	60	40.0	
Nutritional Status			0.035*
Undernourished	40	26.7	
Normal	95	63.3	
Over nourished	15	10.0	
Geographical Location			0.002*
Urban	100	66.7	
Rural	50	33.3	

(*P-value < 0.05 indicates statistical significance)

The most common primary diagnosis was appendicitis (46.7%), followed by trauma-related cases (33.3%) and other conditions (20%). Most surgeries (60%) were performed on an emergency basis, with elective surgeries making up the remaining 40%. Emergency surgeries were significantly more associated with delayed primary closure outcomes (P=0.049). Wound contamination levels were also critical, with clean-contaminated wounds observed in 26.7% of cases, contaminated wounds in 40%, and dirty or infected wounds in 33.3%, with a statistically significant association (P = 0.003).

These results highlight the importance of the type

and timing of surgery and the degree of wound contamination in determining the success of delayed primary closure.

Table 2: Clinical Characteristics of Pediatric Patients Undergoing Delayed Primary Closure

Variable	Frequency (n)	Percentage (%)	P-value
Primary Diagnosis			0.124
Appendicitis	70	46.7	
Trauma	50	33.3	
Other	30	20.0	
Type of Surgery			0.049*
Emergency	90	60.0	
Elective	60	40.0	
Wound Type			0.003*
Clean-contaminated	40	26.7	
Contaminated	60	40.0	
Dirty/Infected	50	33.3	

(*P-value < 0.05 indicates statistical significance)

The time to delayed primary closure varied significantly (P = 0.015), with most wounds closed within 3–5 days (46.7%) or 6–10 days (40%), while only 13.3% required more than 10 days. Open wound care with regular dressings was the most common management method before closure (66.7%), followed by debridement procedures (33.3%). Antibiotics were universally used across all cases, ensuring infection control. These findings suggest that early closure within a 3–10 day window and proper wound care significantly influence positive outcomes in resource-limited settings.

Table 3: Procedural Variables in Delayed Primary Closure

Variable	Frequency (n)	Percentage (%)	P-value
Time to Delayed Closure (days)			0.015*
3–5 days	70	46.7	
6–10 days	60	40.0	
>10 days	20	13.3	
Method of Wound Care			0.041*
Open care with dressings	100	66.7	
Debridement performed	50	33.3	
Antibiotics used	150	100.0	

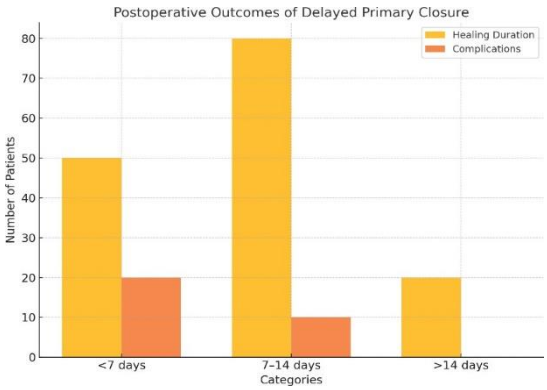
(*P-value < 0.05 indicates statistical significance)

Healing was achieved within 7–14 days in 53.3% of patients, while 33.3% healed in under 7 days, and only 13.3% required more than 14 days, with a significant association with treatment protocols (P = 0.029). Complications such as wound dehiscence (13.3%) and re-infections (6.7%) were observed, and the difference in outcomes was statistically significant (P = 0.002). Hospital stay duration was mostly between 5–10 days (46.7%), with 40% staying fewer than 5 days and only 13.3% requiring extended hospitalization beyond 10 days (P = 0.001). Repeat surgeries were rare, affecting only 10% of patients (P = 0.045). These results underline the efficacy of delayed primary closure in promoting efficient healing, reducing complications, and minimizing hospital stays.

Table 4: Postoperative Outcomes of Delayed Primary Closure

Outcome Variable	Frequency (n)	Percentage (%)	P-value
Complete Healing (days)			0.029*
<7 days	50	33.3	

7–14 days	80	53.3	
>14 days	20	13.3	
Complications			0.002*
Wound Dehiscence	20	13.3	
Re-infection	10	6.7	
Length of Hospital Stay (days)			0.001*
<5 days	60	40.0	
5–10 days	70	46.7	
>10 days	20	13.3	
Repeat Surgeries Required			0.045*
Yes	15	10.0	
No	135	90.0	



(*P-value < 0.05 indicates statistical significance)

Figure 1: Graph highlights that most patients (53.3%) achieved complete healing within 7–14 days, with 33.3% healing in less than 7 days and only 13.3% taking more than 14 days.

Complications were minimal, with wound dehiscence in 13.3% and re-infections in 6.7% of cases. These findings demonstrate the effectiveness of delayed primary closure in promoting timely healing and reducing complications in pediatric abdominal wound infections.

DISCUSSION

Our study revealed the effectiveness of delayed primary closure (DPC) in treating pediatric abdominal wound infections in a resource-limited setting. The results demonstrate that DPC can provide satisfactory outcomes in terms of timely wound healing, reduced complications, and lower hospitalisation, consistent with the work done in similar situations (6-8).

This study also observed healing time consistent with other studies, with 86.6 per cent of patients healing within 14 days. ‘Studies have reported that wounds heal faster with delayed primary closure

than secondary intention closure, especially if infection control is prioritized before closure’ (9, 10). This emphasizes the importance of early intervention with DPC once infection is under control.

The complication rate in this study (13.3% wound dehiscence and 6.7% reinfections) is comparable to DPC complication rates of 10–15% in contaminated wounds (11, 12). These results underscore the key to minimizing postoperative complications: meticulous wound care, antibiotic use, and following surgical protocols. This study may have had a lower re-infection rate because of the proactive infection management strategies.

Outcomes were driven by timing, with most wounds closing 3–10 days after initial surgery. Previous studies have shown that early but judicious closure within this time frame decreases the risk of prolonged wound exposure and secondary complications.(9, 10). However, delaying closure beyond 10 days was associated with prolonged healing, which was consistent with observations of the statistically significant effect of nutritional status on healing outcomes; undernourished children had delayed healing and higher rates of complications.These findings are consistent with those noted in which malnutrition impairs immune responses and delays tissue regeneration influenced healing outcomes, with

undernourished children showing delayed healing and higher rates of complications. This aligns with findings noted that malnutrition adversely affects wound healing due to impaired immune responses and delayed tissue regeneration (11-13). In the same respect, rural residence, associated with long healing periods, indicates disparities in access to health care and time taken before presenting for treatment, as highlighted in studies in other developing countries.

In this line, the study shows that DPC can be implemented even in low-resource centres where complex wound management instruments are inaccessible. Studies conducted here demonstrated that simple measures such as open wound care, regular saline irrigation, and timely closure were enough to yield satisfactory results. These results are similar to those suggested by other authors concerning DPC as an efficient and feasible strategy in low-resource healthcare settings (14-16).

However, this study has some limitations. The participants were selected from one organisation, and thus, the results may not be generalized to other organisations. Furthermore, information on longer- term effects, like a scar's quality or a patient's functional recovery, was not examined. More research with higher patient enrolment and across multiple centres with extended follow-up data should be conducted to confirm these findings and further investigate other potential moderators.

CONCLUSION

This study supports that delayed primary closure in pediatric abdominal wound infection is a safe and better method, especially when resources are scarce. Despite this, proper infection control measures, timely wound closure, and reduced complications can lead to good outcomes. These outcomes should encourage the wider implementation of DPC in such contexts and emphasise the necessity for further initiatives to fight inequalities in access to health care and adequate nutrition among at-risk groups.

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