



Comparative Outcomes of Laparoscopic vs. Open Appendectomy for Children with Perforated Appendicitis

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Abstract

Background: Perforated appendicitis in children requires surgical intervention and antibiotic treatment after surgery, and may be influenced by surgical technique, the extent of the disease, surgical skill, and hospital protocol. The evidence for pediatrics suggests that laparoscopy will shorten hospital stay, though the findings differ depending on the operative time.

Background: Although the laparoscopic approach to appendectomy has been proven superior to open surgery in adult patients with perforated appendicitis, it has not yet been compared to open surgery in studies of children with perforated appendix.

Objective: To compare the laparoscopic and open appendectomy in a pediatric population with perforated appendicitis with respect to age, operative time, post-operative hospital stay, and other outcomes that were thought to be applicable.

Methods: This was a retrospective comparative cohort study of 103 pediatric patients who underwent appendectomy between 1 June 2024 and 1 June 2026 with the inclusion of patients confirmed as having perforated appendicitis for the study cohort: 54 laparoscopic and 49 open appendectomy. Operative duration, surgical approach, age, admission and discharge dates were analyzed. Between-group comparisons were made using the Mann-Whitney U test and a p value of <0.05 was deemed significant. In the comparative data no individual records of the extent of perforation and/or presence of an accompanying abscess were available.

Results: There were 103 patients included, all of whom had perforated appendicitis and 54 underwent laparoscopy for appendectomy and 49 underwent open appendectomy. Mean age was 9.37 ± 2.68 versus 9.07 ± 3.08 years ($p=0.685$). Mean operative duration was 54.54 ± 12.71 versus 115.10 ± 17.21 minutes ($p<0.001$), and mean hospital stay was 3.59 ± 1.11 versus 5.88 ± 2.83 days ($p<0.001$), respectively. A record of an open surgery was excluded from stay analysis because the date of discharge was impossible to determine.

Results: Laparoscopic appendectomy was found to be related to shorter operative time and less duration of hospitalization in children with perforated appendicitis. The observed findings should be interpreted with caution as there were no controls for the extent of perforation, the number of abscesses, treatment routes, or postoperative complications.

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Keywords: perforated appendicitis, paediatric appendectomy, laparoscopy, open appendectomy, operative time and hospital stay

1. Introduction

Acute appendix is the most frequent emergency surgery in children. Perforation is a clinically significant complicated appendicitis that is usually accompanied by peritoneal contamination, antimicrobial treatment and a more rigorous post-appendectomy course. This research focuses on the surgical approach particularly in children in whom appendicitis is perforated [1,2,3,4].

There is recent pooled evidence across children with all types of appendicitis that laparoscopy is associated with shorter hospitalisation and earlier oral intake, but these are large cohorts that may not be directly applicable to children who have perforated appendicitis^[5]. A comparison is only possible between the two diseases when both are perforated, but this simplifies the clinical picture, and there may be important differences in the contamination or in the presence of abscess in the two groups within the limits of the disease. Pediatric appendicitis is a disease with multiple aetiologies. This can be caused by luminal obstruction, lymphoid hyperplasia, microbial factors, host susceptibility, access to care. Although all patients have the same eligibility criterion based on perforations, the amount of peritonitis or abscess can vary widely among patients with perforated disease^[2,4]. Children, especially younger ones, may not be as easy to diagnose. A significant risk of perforation and peritonitis is related to delayed or missed diagnosis. When presenting a specific outcome (e.g., perforation) the age of the child is relevant for presentation as well as operative complexity and recovery; comparing age across surgical groups helps explain the observed outcome^[6,7].

There have been various operative definitions of perforation, such as a visible hole in the appendix or a free fecalith in the peritoneum^[8]. Other studies require the confirmation by the operation and histological examination^[9]. Definitions have an impact on who enters into a study and how results can be compared. This manuscript is based upon the investigators' clarification that all the children included here had perforated appendicitis, but there is no separate field for perforation in the available comparative spreadsheet.

Appendectomy continues to be a key surgical procedure used for acute appendicitis. The current evidence based guidelines from the World Society of Emergency Surgery (WSES) and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) focus on both operative and non-operative approaches, highlighting disease severity, patient-specific factors, local expertise, and technical considerations. When surgery is performed, the laparoscopic approach is the most common minimally invasive technique that is increasingly adopted at many children's hospitals^[1,7,10].

Laparoscopic appendectomy is associated with smaller incisions, better visualization of the abdomen, and possibly less time to recover from surgery than open appendectomy. Surgical-site-infection, return to oral intake, and quicker return to normal activity have been generally reported lower in the paediatric setting and earlier hospital discharge, with lower use of analgesia, following laparoscopy in pediatric meta-analyses. In terms of the benefits, however, the figures are not consistent across studies and operative duration has been especially variable^[11,12,13,14].

Evidence from studies of complicated pediatric appendicitis is especially applicable to this all-perforated group, but also some studies include gangrene or appendix abscess without proof of perforation. Meta-analyses of the pediatric literature have shown shorter hospitalizations following laparoscopy, but the result for operative-time has been less consistent, with many studies favoring open surgery. This is also supported by a meta-analysis, specifically focused on children with perforated appendicitis^[11,12,15].

Different estimates have been obtained from direct observations of children with perforated appendicitis. Another study by Yagmurlu *et al.* reported that laparoscopy resulted in less wound infection and no difference in mean hospital stay or intra-abdominal abscess^[16]. Broadly similar complication rates for laparoscopy and laparotomy were observed by Vahdad *et al.*^[9]. Nadler *et al.* also reported comparable rates of infectious complications and emphasized the importance of using a consistent postoperative management of these techniques^[17].

Antimicrobial treatment may be needed and, in certain cases, treatment for abscess or infected collections may be necessary for perforated appendicitis. There are various routes of treatment in each institution. A variety of factors including differences in surgical timing, antibiotic policy, extent of the abscess and extent of peritoneal contamination can influence outcome even in the presence of perforation in both surgical groups^[4].

Management is also different after the removal of the appendix (appendectomy). A pediatric randomized trial showed no benefit from irrigation during laparoscopic appendectomy that would reduce the rate of postoperative abscesses compared with irrigation by suction alone [8]. Antibiotic duration and discharge criteria are also important – Theodorou *et al.* reported fewer discharge prescriptions following a guideline change, and surgical-site infection (unadjusted) did not continue following multivariable adjustment^[18]. These factors of care should be recorded prior to claiming the surgical route was the sole reason for the difference.

The following information should be entered to complete a comparison with perforated appendicitis: age, sex, weight/BMI, extent of perforation and contamination, abscess or phlegmon, operative duration, conversion, use of drain, oral intake, antibiotic use, hospital admission, surgical-site infection, intra-abdominal abscess, re-admission and reoperation^[4,10,11,12,13,14,15,19].

The institution specific findings continue to play an important role, as they influence outcome, which will depend on surgeon experience, patient selection, operating room workflow, the degree of perforated disease, antibiotic policy, and discharge policy. This study compares only children with perforated appendix to those who have laparoscopic and open operations on appendix, based on the available admission-to-discharge data, age and operative duration. Further clinical information is required to explain the differences in severity of this group.

1.1. Aim and Objectives

The purpose of the study was to determine the clinical and perioperative outcomes between the two surgical procedures in a series of children who had perforated appendicitis.

To determine if there is a difference in age distribution between the laparoscopic and open appendectomy groups.

To compare the time required for the operation in the two surgical methods.

To compare length of stay in hospital from admission to discharge.

To find out if the differences in the main outcomes are due to a big difference in age.

To pinpoint key complication and recovery factors that are needed for a more thorough examination.

1.2. Study Hypothesis

The working assumption was that the surgical approach was correlated with operative duration and hospital stay among perforated appendicitis children. Shorter length of hospital stay was anticipated with laparoscopy and the operative-time difference was determined empirically [11,12,15].

2. Materials and Methods

Since this is a clinical surgical study, as opposed to a chemistry lab experiment, the “Materials” section will refer to the patient records, variables, and clinical data sources that will be used as material for the analysis.

2.1. Study Design and Period

This backward-looking approximate cohort study secondhand usually recorded emergency room dossier for youngsters with punctured appendicitis the one underwent appendectomy betwixt 1 June 2024 and 1 June 2026. Patients were top-secret in accordance with laparoscopic or open surgical approach. Perforated status for the whole follower was supplied as a study-level explanation; the approximate spreadsheet acted not hold different patient-level perforation field.

2.2. Study Setting

The study was administered at [put ward name], [put department], [city], [country]. The exact uniform name endure be introduced before chronicle compliance.

2.3. Study Population

The disciple comprised 103 pediatric inmates with punctured appendicitis: 54 (52.4%) had laparoscopic appendectomy and 49 (47.6%) underwent open appendectomy.

2.4. Eligibility Criteria

Eligibility was limited to pediatric cases with punctured appendicitis bearing appendectomy all along the study ending, with recorded surgical approach, age, and influential event. Perforation rank for all included subjects was habitual apiece study clarification but was not alone systematize in the approximate computer program. Valid admission and discharge dates were furthermore necessary for stay reasoning; hopeless date sequences were excluded only from that study.

2.5. Available Study Variables

The approximate dataset contained age, surgical approach, functioning event, admittance date, and discharge date. All contained sufferers were stated to have punctured

appendicitis; patient-level fields for prick range, swelling, and adulteration were nonexistent. Hospital stay was derived as discharge date diminished admittance date.

2.6. Outcome Definitions

Primary resolved outcomes were influential event and hospital distance of stay. Age was medicated as a baseline approximate variable. Recommended subordinate consequences for future chart extraction contain surgical-home infection, following-abdominal swelling, ileus/impediment, drain placement, adaptation to open resection, readmission, reoperation, time to spoken intake, medicine event, analgesic necessity, continue normal venture, and treatment cost.

2.7. Data Quality and Cleaning

Dates and mathematical principles were hindered for within regularity. One open-surgery patient conceded on 31 December 2025 had a written discharge date in January 2025, bearing a negative distance of stay; this record was forbade from the distance-of-stay prediction but kept for age and functioning-occasion analyses. The additional laparoscopic text was not absorbed at patient level cause allure patient identifiers acted not equal the approximate disciple.

2.8. Statistical Analysis

Continuous variables were outlined as mean $\pm$ predictable difference and middle with interquartile range (IQR). Distributional powers were determined accompanying the Shapiro-Wilk test. Because age, functioning event, and hospital time of stay demonstrated evidence of non-mediocrity in not completely one group, the Mann-Whitney U test was secondhand for basic 'tween-group contrastings. Mean dissimilarities and approximate 95% confidence breaks were furthermore stated for dispassionate understanding. Statistical significance was judged a mutual $p < 0.05$.

2.9. Ethical Considerations

Before compliance for disclosure, the manuscript bear involve the approving uniform morality committee, authorization/remark number, and the basis for postponement of individual consent if appropriate. No morality approval number endure be introduced unless it has indeed existed issued.

2.10. Essential Parameters for a Complete Surgical Outcomes Study

The following limits are accurately appropriate for an extended corresponding. They are listed as urged variables; no profit or difficulty rate is designated when the current approximate dataset does not hold that facts.

Table 1

Domain	Parameter	Recommended definition	Status
Baseline	Age	Years	Available
Baseline	Sex	Male/Female	Not in comparative file
Baseline	Weight/BMI	kg; kg/m ²	Not in comparative file
Disease severity	Appendicitis severity	Extent of perforation; localized/diffuse peritonitis; abscess	Not consistently available
Disease severity	Perforation	Yes/No	All patients: yes (study clarification)
Preoperative	WBC / neutrophils / CRP	Laboratory values at presentation	Not in comparative file
Intraoperative	Operative time	Minutes	Available
Intraoperative	Conversion to open	Yes/No	Not in comparative file
Intraoperative	Drain placement	Yes/No	Not in comparative file
Intraoperative	Estimated blood loss	mL	Not in comparative file
Recovery	Time to oral intake	Hours	Not in comparative file
Recovery	IV/total antibiotic duration	Days	Not in comparative file
Recovery	Analgesic requirement	Doses/days	Not in comparative file
Recovery	Hospital length of stay	Days	Available
Complications	Surgical-site infection	Yes/No within defined follow-up	Not in comparative file
Complications	Intra-abdominal abscess	Imaging-confirmed/intervention-requiring	Not in comparative file
Complications	Ileus/intestinal obstruction	Yes/No	Not in comparative file
Complications	Readmission	Preferably ≤ 30 days	Not in comparative file
Complications	Reoperation/intervention	Preferably ≤ 30 days	Not in comparative file
Recovery	Return to normal activity/school	Days	Not in comparative file
Resource use	Treatment cost	Consistent currency/method	Not in comparative file

3. Results and Discussion

Results are bestowed in addition to their interpretation and contrasting accompanying former literature, following the linked Results-and-Discussion plan wanted for this script.

3.1. Patient Distribution and Age

All 103 offsprings in the comrade had punctured appendicitis: 54 (52.4%) underwent laparoscopic and 49 (47.6%) open appendectomy. Mean age was 9.37 ± 2.68 and 9.07 ± 3.08 age, individually. Median age was 9.5 (IQR 7–

12) and 10 (IQR 7–12) age, individually (Mann-Whitney U, $p=0.685$).

The comparable age distributions reduce concern about a big age inequality betwixt surgical groups. Nevertheless, punctured appendicitis changes in range, and age similarity unique cannot base corresponding peritoneal adulteration, swelling burden, or clinical asperity. This limits understanding of distinctnesses ineffectual event and hospital stay [4,6,19].

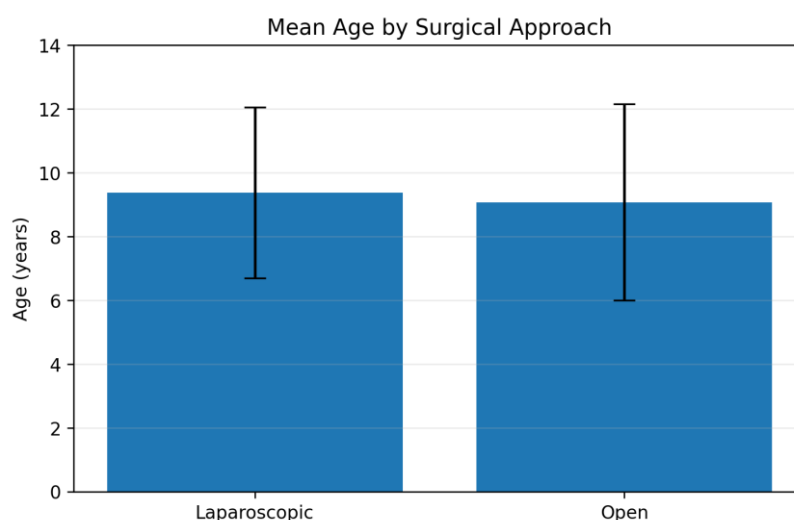


Fig 1: Mean age ($\pm$ SD) in laparoscopic and open appendectomy groups.

3.2. Operative Duration

Operative event was markedly smaller in the laparoscopic group. Mean functioning time was 54.54 ± 12.71 notes of meeting for laparoscopic appendectomy distinguished with 115.10 ± 17.21 notes of meeting for open appendectomy. Median active time was 50 summary (IQR 45–60) against 120 minutes (IQR 100–120), individually. The distinctness was highly statistically important ($p<0.001$). The mean dissimilarity for laparoscopic minus open enucleation was -

60.57 notes of meeting (95% CI approximately -66.54 to -54.59).

The functioning-opportunity finding contrasts accompanying pediatric combined evidence in complicated appendicitis: Low and others. and Neogi and others. reported smaller operative occasion accompanying open surgery [11,12]. Those combined societies may contain forms of difficult disease apart from prick; comparisons accompanying the all-perforated disciple must give reason for that difference.

Evidence met expressly on perforated pediatric appendicitis is likewise appropriate [15].

Two perforation-particular backward-looking studies provide valuable contrastings. Yagmurlu *et al.* stated akin operative event between approaches, when in fact the cohort shows a much best distinctness favoring laparoscopy [16]. Vahdad and others. judged surgically and histologically confirmed breach [9]. Without physician-level data, occasion from confirmation to surgery, adulteration grade, and the commonness of conversions, it is not possible to decide that

differences useless plan explain the verdict.

Differences in physician experience, system, swelling burden, adhesions, extent of adulteration, and selection of more intricate punctured cases for an open approach may clarify the abundant observed active-lapse of time. Perforation was present in every patient, but allure asperity was not measured at patient level; the noticed partnership therefore does not authenticate an basic time benefit of laparoscopy.

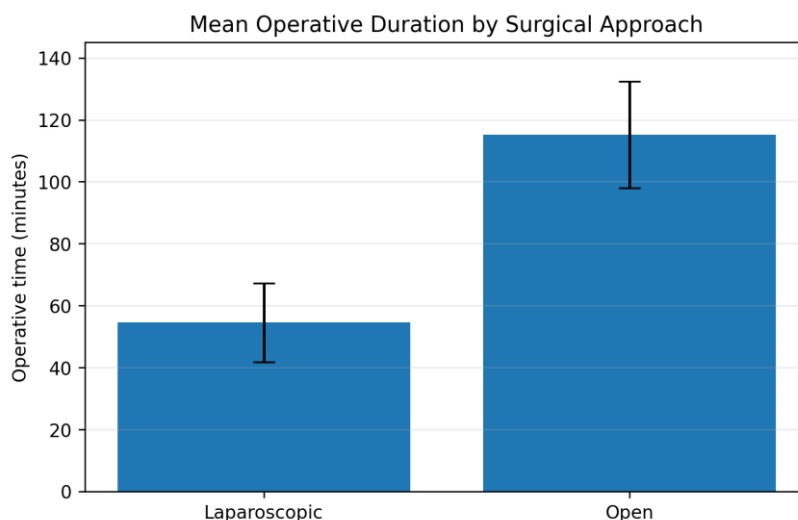


Fig 2: Mean operative duration ($\pm$ SD) in laparoscopic and open appendectomy groups.

3.3. Hospital Length of Stay

After forbiddance of individual open-surgery record accompanying an absurd discharge date, hospital time of stay was resolved in 54 laparoscopic and 48 open cases. Mean stay was 3.59 ± 1.11 days afterwards laparoscopic appendectomy and 5.88 ± 2.83 days after open appendectomy. Median stay was 3 days (IQR 3-4) and 5 days (IQR 4-6), individually. The dissimilarity was statistically meaningful ($p < 0.001$). The mean difference for laparoscopic diminished open section was -2.28 days (95% CI approximately -3.15 to -1.41).

Shorter treatment later laparoscopy is constant with pediatric evidence in difficult appendicitis [11,12,13] and is having to do with studies specifically checking punctured affliction [15]. The approximately 2.3-era distinctness in this companion can too reflect difference in peritoneal adulteration, medicine regimens, drain use, or discharge practice, that the current dossier cannot assess.

The noticed 2.28-era mean stay dissimilarity exceeds the

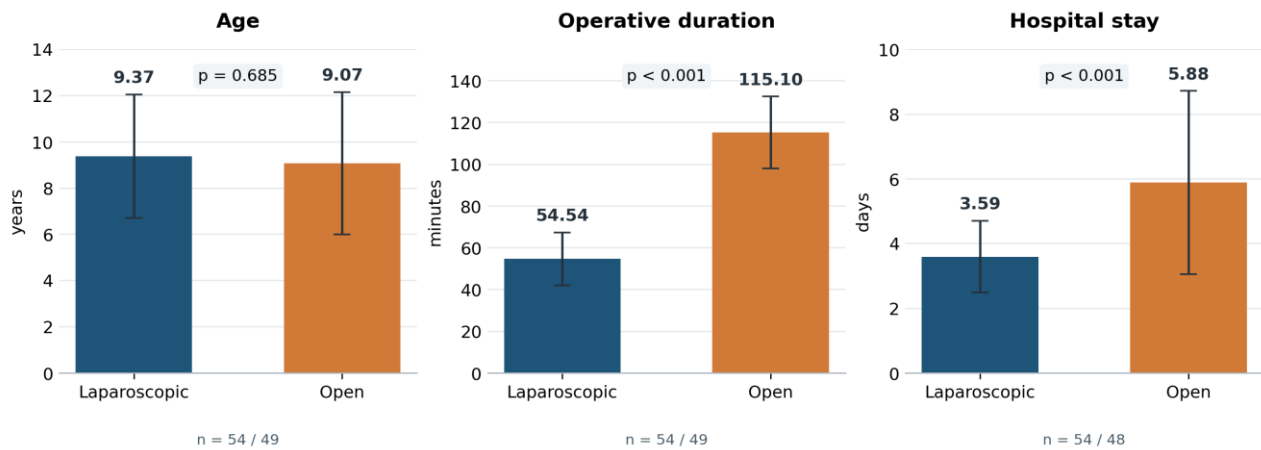
combined decline reported in few difficult-appendicitis contrastings [11,12]. It should be distinguished tentatively with studies limited to prick: Yagmurlu and others. found no statistically meaningful stay distinctness, and Nadler and others. also noticed akin stays [16,17]. Different discharge protocols and swelling burdens keep seemingly account for differing estimates. Because this study measures admittance-to-discharge time, delays before resection concede possibility likewise contribute.

Shorter treatment concede possibility indicate less wound trauma, former group, earlier resistance of spoken consumption, lower analgesic necessities, minute wound-related snags, and local discharge pathways. Esposito and others. stated earlier renewal of sane diet, shorter regimen, and faster continue common activity following in position or time laparoscopic appendectomy in youth, while fuller randomized evidence has also connected laparoscopy accompanying faster postoperative restoration [14,20].

3.4. Main Comparative Results

Table 2

Variable	Laparoscopic	Open	p-value
Patients, n	54	49	-
Age, years, mean $\pm$ SD	9.37 $\pm$ 2.68	9.07 $\pm$ 3.08	0.685
Age, median (IQR)	9.5 (7-12)	10 (7-12)	0.685
Operative time, min, mean $\pm$ SD	54.54 $\pm$ 12.71	115.10 $\pm$ 17.21	<0.001
Operative time, median (IQR)	50 (45-60)	120 (100-120)	<0.001
Hospital stay, days, mean $\pm$ SD	3.59 $\pm$ 1.11 (n=54)	5.88 $\pm$ 2.83 (n=48)	<0.001
Hospital stay, median (IQR)	3 (3-4)	5 (4-6)	<0.001



Note: All victims had punctured appendicitis. p-values are from Mann-Whitney U tests. One open-abscession record was expelled from emergency room-stay reasoning by way of an impossible discharge date.

Fig 1: Age, active event, and confirmation-to-discharge hospital stay by surgical approach in adolescents accompanying punctured appendicitis. Bars signify group method; error bars signify standard departures. P principles are from Mann-Whitney U tests. The nursing home-stay study expels one open-resection record accompanying an absurd discharge date.

3.5. Complications and Additional Outcome Parameters

Postoperative depression is central to equating surgical approaches for punctured appendicitis. Relevant outcomes involve surgical-section infection, following a time-intestinal abscess, medical checkup ileus or impediment, readmission, reoperation, oral consumption, medicine duration, and painkiller needs. Pediatric studies of complicated and punctured disease address these consequences, but their public and treatment codes vary [4,11,12,15,16].

Infection is especially appropriate in punctured disease. Zhang and others. stated fewer wound contaminations but more event-abdominal abscesses afterwards laparoscopic medical procedure in a perforation-distinguishing meta-reasoning [15], whereas Low and others. reported akin swelling risk in a wider difficult-appendicitis state [12]. An older direct corresponding erect fewer wound contaminations accompanying laparoscopy but comparable swelling rates [16]. These results concede possibility be presented as specific study verdicts, not combined into an pretended complication rate for the cases.

Evidence concerning event-intestinal abscess subsequently laparoscopic incision remains assorted. A meta-reasoning confined to punctured pediatric appendicitis stated a higher swelling risk afterwards laparoscopy, whereas a later combination of complicated appendicitis establish identical rates between approaches [12,15]. This conflict warrants patterned recording of swelling, wound contamination, and at least 30-era readmission and reoperation; the current disciple has no complication counts for either approach.

Drain installation endure be analyzed individually from difficulties because it is two together a tombstone of disease asperity and a management conclusion. Contemporary SAGES counseling does not support routine drainage later appendectomy for difficult appendicitis. Similarly, antibiotic event bear be captured cause punctured appendicitis remains guide solid institutional alternative in examination antimicrobial practice and stewardship [4,10].

The analyses of postoperative administration too deserve consideration. In a randomized trial, watering did not weaken swelling formation relating to removal of liquid alone all along laparoscopic surgery for punctured appendicitis [8]. Theodorou and others. examined a discharge-medicine direction among adolescents accompanying perforation and

establish that smaller prescribing was feasible in picked patients, but the security signals demand cautious understanding [18]. Missing facts on irrigation, medicines, and discharge tests therefore limits contrasting of postoperative improvement in this place cohort.

The current corresponding cannot specify valid rates for these examination consequences because complete doubled patient-level confusion data are missing. All patients are stated to have punctured appendicitis; further chart extraction concede possibility then focus on the functioning or study of plants evidence of perforation, allure magnitude, abscess or wordy peritonitis, drain use, antibiotic event, complexities, and readmissions. No complication rates endure be implicit from the available computer program.

In this follower confined to punctured appendicitis, laparoscopy was guide shorter clinic stay and, contrary to few combined pediatric findings, smaller active time. Unmeasured dissimilarities in prick extent and pick of surgical approach prevent a fresh understanding [11,12,15].

3.6. Strengths and Limitations

Strengths contain patient-level active and stay dossier, a predefined ending, contrasting of two surgical approaches inside a punctured appendicitis cohort, and unambiguous labeling of an invalid discharge date. Age distributions were analogous and dissimilarities ineffectual occasion and stay were solid.

The principal disadvantages are the backward-looking design, absent sexuality and anthropometric dossier, omission of patient-level news on perforation magnitude, swelling or peritonitis, unfinished obstacle dossier, and individual invalid discharge date. Perforation was stated for all partners but keep not be alone inspected against a loyal field in the approximate spreadsheet. Hospital stay measures admittance to discharge, not examination stay. The unions endure not be elucidated as new.

4. Conclusions

Among 103 youngsters accompanying perforated appendicitis discussed middle from two points 1 June 2024 and 1 June 2026, age was comparable 'tween laparoscopic and open groups (9.37 ± 2.68 vs 9.07 ± 3.08 age; $p=0.685$). Laparoscopy was guide shorter functioning event ($54.54 \pm$

12.71 vs 115.10 ± 17.21 minutes; $p < 0.001$) and nursing home stay (3.59 ± 1.11 vs 5.88 ± 2.83 days; $p < 0.001$).

These results illustrate this uniform cohort of punctured appendicitis. Comparative security and causality cannot use outside patient-level measures of in consideration of perforation or adulteration, swelling, treatment choice,

medicine uncovering, and postoperative snags.

5. Supporting Information

The following fields are urged for further chart distillation inside this all-punctured comrade; their leaning does not indicate that patient-level calculations are now vacant.

Table 3

Field	Suggested coding	Why it matters
Sex	Male / Female	Baseline comparability
Weight	kg	Baseline and dosing context
BMI	kg/m ²	Potential confounding by body habitus
Appendicitis severity	Extent of perforation / peritonitis / abscess	Variation within perforated disease
Perforation	All yes; verify operative/pathology documentation	Verify study-level eligibility
WBC	$\times 10^9/L$	Inflammatory severity
CRP	mg/L	Inflammatory severity
Operative time	minutes	Efficiency outcome
Conversion to open	0=No, 1=Yes	Technical outcome
Drain	0=No, 1=Yes	Management/severity marker
Oral intake	hours	Recovery outcome
IV antibiotics	days	Treatment burden
Hospital stay	days	Resource/recovery outcome
Surgical-site infection	0=No, 1=Yes	Postoperative morbidity
Intra-abdominal abscess	0=No, 1=Yes	Important complication
Ileus/obstruction	0=No, 1=Yes	Important complication
Readmission ≤ 30 d	0=No, 1=Yes	Safety outcome
Reoperation/intervention ≤ 30 d	0=No, 1=Yes	Major morbidity
Return to normal activity	days	Patient-centered recovery
Cost	numeric, single currency	Resource use

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