Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Pediatric laparoscopy in a resource-limited setting: lessons learned from 81 consecutive procedures over a six-year period in Dakar

Madawase Mboup[1]

madawase@gmail.com

[1]Principal Hospital of Dakar, Armed Forces Teaching Hospital

Biram Ndiaye[1]

[1]Principal Hospital of Dakar, Armed Forces Teaching Hospital

Research Article

Keywords: Pediatric Laparoscopy, Minimally invasive surgery, Africa, Resource-limited setting

Posted Date: June 17th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10035418/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Purpose

Laparoscopy is increasingly adopted in paediatric surgery due to reduced operative trauma, shorter hospital stays, diminished postoperative pain, and improved cosmesis. This study aimed to evaluate the evolution of paediatric laparoscopic practice over six years in a tertiary centre.

Methods

We conducted a retrospective, descriptive, comparative study including all laparoscopic procedures performed between January 2020 and December 2025 in patients aged < 16 years with complete records. Procedures were categorised into three periods: 2020–2021, 2022–2023, and 2024–2025. Variables collected included age, sex, indication, mode of admission, intraoperative incidents, and conversion to open surgery. Statistical analysis employed Chi-square and Kruskal–Wallis tests ($p < 0.05$).

Results

Eighty-one procedures were analysed. Mean age was 7.4 years; 64% of patients were male. Procedural volume increased significantly (6 → 28 → 47; $p < 0.001$). Elective cases rose from 50% to 87% ($p < 0.001$). Mean patient age declined from 11.5 to 6.3 years. Indications expanded to include appendicitis, gallstones, ovarian cysts, inguinal hernia, Hirschsprung's disease, undescended testis, and pelvi-ureteric junction obstruction ($p = 0.02$). Incident and conversion rates were 4.9% and 2.4%, respectively.

Conclusion

Over six years, paediatric laparoscopic surgery increased in volume, encompassed younger patients, and broadened indications, with low incident and conversion rates, supporting its safety and feasibility. Prospective multicentre studies are warranted.

Introduction

Laparoscopy has become the preferred approach for a growing range of paediatric surgical procedures, conferring multiple advantages including reduced operative trauma, diminished postoperative pain, shorter hospitalisation, and improved cosmetic outcomes[1]. Since its adoption, numerous studies have documented an increase in procedural volume, a reduction in the mean age of patients, and an expansion of surgical indications[2, 3]. This study aims to evaluate the evolution of laparoscopic practice over a six-year period within a tertiary paediatric centre, by comparing three discrete intervals: 2020–2021, 2022–2023, and 2024–2025.

Materials and Methods

Study Design

A retrospective, descriptive, comparative analysis was conducted at a single paediatric centre over six years (January 2020–December 2025) to examine the evolution of paediatric laparoscopic practice. Three discrete intervals were compared: 2020–2021, 2022–2023, and 2024–2025.

Study Population

All patients aged < 16 years who underwent laparoscopic surgery within the study period with complete preoperative and intraoperative records were included. Exclusion criteria were open surgery, incomplete records, or procedures performed outside the defined interval.

Variables

Collected variables included age, sex, surgical indication, mode of admission (emergency or elective), intraoperative incidents, and conversion to open surgery.

Data Sources

Data were extracted from medical records, surgical registers, and operative reports of the department. All data were anonymised prior to analysis to preserve patient confidentiality.

Surgical equipment and expertise

Our centre is equipped with three fully functional laparoscopic towers, a complete set of 5 mm and 10 mm laparoscopic instruments, one 5 mm optical system, and three 10 mm optical systems. We also possess a mono- and bipolar electrosurgical unit, together with an ultrasonic generator fitted with 5 mm and 10 mm forceps, permitting precise dissection and effective haemostasis control.

All procedures were undertaken by two paediatric surgeons trained in laparoscopy. One surgeon holds a university diploma in paediatric laparoscopy, and both have attended several international workshops on minimally invasive paediatric surgery. In all cases, entry into the abdominal cavity was achieved using the open laparoscopy (Hasson) technique.

Surgical techniques according to indication

Acute appendicitis

antegrade appendicectomy, most frequently performed utilising three trocars.

Gallstones

retrograde cholecystectomy using four trocars, ligation of the cystic pedicle with endoclips, and intra-operative cholangiography when indicated.

Cryptorchidism(non-palpable testis) : laparoscopic exploration to identify the position of the testis. Management depended upon intra-operative findings:

- Closed inguinal ring with engagement of the spermatic pedicle: inguinal approach.
- Open inguinal ring: intra-abdominal testis or testis located within the deep inguinal ring, managed with either single-stage laparoscopic orchidopexy or the Shehata two-stage technique.
- In cases of agenesis or vanishing testis: systematic contralateral orchidopexy.

Benign ovarian cyst

cystectomy performed with the cyst intact (closed cystectomy).

Inguinal hernia

laparoscopic repair using the PIRS technique (Darius Patkowski).

Hirschsprung's disease

laparoscopic-assisted colonic pull-through, including colonic mobilisation with an ultrasonic scalpel to the pelvic floor, perineal stage, and laparoscopic confirmation of colonic descent (commonly utilising three trocars).

Obstruction of the pelvi-ureteric junction

transperitoneal laparoscopic pyeloplasty after parietal-colic mobilisation to access the renal lodge, with systematic placement of a double-J stent.

Differences of sex development (DSD)

laparoscopic exploration to evaluate the presence and position of gonads, with biopsy if indicated, and gonadectomy where appropriate (e.g. ovotestis).

Peritoneal lymphadenopathy

laparoscopic lymph node biopsy for histopathological and aetiological assessment.

Acute intestinal intussusception

laparoscopic reduction — indicated in cases of diagnostic uncertainty; otherwise, radiological management was preferred.

Periods Compared

Procedures were categorised into three periods:

- Period 1: January 2020 – December 2021
- Period 2: January 2022 – December 2023
- Period 3: January 2024 – December 2025

Statistical Analysis

Quantitative variables (e.g. age, number of procedures, operative time) are presented as mean ± standard deviation. Qualitative variables (e.g. sex, type of procedure, mode of admission) are expressed as counts and percentages. Comparisons between periods were performed using the Chi-squared test for categorical variables and the Kruskal–Wallis test for continuous variables, given the non-normal distribution of the data. Statistical significance was defined as $p < 0.05$.

Ethical Considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki and approved by the institutional ethics committee. Informed consent was obtained in accordance with applicable regulations for retrospective studies. All data were treated confidentially and anonymised.

Results

A total of 81 laparoscopic procedures were performed between January 2020 and December 2025. The mean patient age was 7.4 years (range: 1–15 years). Boys accounted for 64% of cases and girls for 36%. The annual distribution of procedures is illustrated in Fig. 1.

The overall conversion rate to open surgery was 2.4%, and the intraoperative incident rate was 4.9%. Reported incidents included a pyelic breach, a diaphragmatic breach, an omental breach, and a gallbladder injury. The majority of procedures were elective (84%), with 16% undertaken on an emergency basis (Table 1).

Change in Procedural Volume: There was a significant increase in the number of procedures over time, rising from 6 in [2020–202] to 28 in [2022–2023], and further to 47 in [2024–2025] ($p < 0.001$).

Mode of Admission: The proportion of elective procedures increased from 50% in [2020–2021] to 86% in [2022–2023], and further to 87% in [2024–2025] ($p < 0.001$).

Average Patient Age: The mean patient age decreased from 11.5 years in]2020–2021] to 6.3 years in [2024–2025].

Surgical Indications: Indications for laparoscopic surgery evolved over time. In the earlier periods, appendicitis, gallstones, and ovarian cysts predominated. More recent years have seen the emergence of

additional indications, including inguinal hernia, Hirschsprung's disease, non-palpable testis, and pelvi-ureteric junction obstruction (p = 0.02) (Table 2).

Incident and Conversion Rates: No intraoperative incidents were recorded in the first two periods; the incident rate was 4.2% in [2024–2025]. Conversion to open surgery was 0% in [2020–2021], 3.4% in [2022–2023], and 2.1% in [2024–2025].

Table 1
Comprehensive Synthesis of Global Results

Variables	**Results**
Total number of procedures	81
Mean âge	7,4 years(1–15)
Sex	Femme : 29 (36%) Male : 52 (64%)
Overall conversion rate	2,4%
Intraoperative incident rate	4,9%
Types of intraoperative incidents	Pyelic injury (n = 1) Diaphragmatic injury (n = 1) Omental injury (n = 1) Gallbladder injury (n = 1)
Mode of intervention	Emergency : 13 (16%) Elective surgery: 68 (84%)

Table 2
Temporal evolution of indications during the study periods

Indications	[2020–2021]	[2022–2023]	[2024–2025]
Appendicitis	3	5	6
Gallstones	2	9	7
Ovarian cysts	1	1	0
Non-palpable testes	0	8	11
Disorder of sex development	0	2	0
Acute intussusception	0	1	0
Hirschsprung's disease	0	1	6
Inguinal hernia	0	1	13
Pelvi-ureteric junction obstruction	0	0	2
Intra-abdominal foreign body	0	0	1
Peritoneal ymphadenopathy	0	0	1

Discussion

Analysis of our data reveals a continuous increase in the volume of procedures and a diversification of surgical indications, consistent with previous reports demonstrating the gradual adoption of minimally invasive surgery in paediatric practice. Meinzer and al.[3] observed a significant rise in surgical volume and expansion of indications, while Lopez[4] reported a reduction in the average age of patients undergoing minimally invasive procedures.

The reduction in mean patient age in our series suggests growing technical expertise and greater confidence in applying laparoscopy to younger patients, in line with findings by Bax et al.[5] and Patti et al.[6], who described a progressive extension of indications for paediatric laparoscopic surgery. This evolution is supported by advances in technology and specialised surgical training[7, 8].

Our findings of low incidence rates (4.9%) and conversion rates (2.4%) further support the safety of the technique. These figures are comparable with, or superior to, those reported in the literature. For example, Di Fabrizio et al.[9] reported a conversion rate of 5.8% and an incidence rate of 7% in paediatric robot-assisted laparoscopy. These results emphasise that paediatric laparoscopy, when performed in a centre with appropriate expertise, offers a high safety profile.

However, this study has limitations. As a retrospective, single-centre study with a relatively small sample size, the generalisability of our findings is restricted. Additionally, the variations observed may be

influenced by contextual factors such as equipment availability, staff expertise, and institutional priorities.

Prospective, multicentre studies are warranted to validate these observations, assess the impact of ongoing professional training, analyse factors influencing complication and conversion rates, and develop standardised protocols adapted to the African context

Conclusion

Over the past six years, minimally invasive paediatric surgery has undergone steady growth in both case volume and spectrum of indications. The observed reduction in mean patient age, broadening of indications, and increase in elective procedures reflect a marked expansion of this technique, accompanied by low rates of complications and conversion to open surgery.

Declarations

Ethics approval and consent to participate

This retrospective study was conducted at the Principal Hospital of Dakar (Armed Forces Teaching Hospital), Senegal. The study was approved by the institutional ethics committee and conducted in accordance with the principles of the Declaration of Helsinki. Due to the retrospective nature of the study, the requirement for informed consent was waived.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Author Contribution

Author contributionsM.M. contributed to the conceptualization, methodology, data analysis, and drafting of the manuscript. B.N. contributed to data collection and critical revision of the manuscript. All authors read and approved the final manuscript.

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

1. Esposito C, Escolino M, Bailez M, Rothenberg S, Davenport M, Saxena A (2017) Malpractice in paediatric minimally invasive surgery - a current concept: results of an international survey. Med Sci Law 57(4):197–204
2. Cassaro F, Impellizzeri P, Romeo C, Arena S (2025) Comparative outcomes of laparoscopic and open surgery in inflammatory bowel disease in pediatric and young adult patients: a systematic review and meta-analysis. J Gastrointest Surg 29(7):102085
3. Meinzer A, Alkatout I, Krebs TF, Baastrup J, Reischig K, Meiksans Ral (eds) (2020) Advances and trends in pediatric minimally invasive surgery. J Clin Med. ;9(12):3999
4. Lopez M (2015) L'approche mini-invasive en chirurgie pédiatrique: de la révolution à l'évolution d'une nouvelle approche chirurgicale [thèse]. Saint-Étienne (FR). Université Jean Monnet
5. Bax NM (2005) Laparoscopic surgery in infants and children. Eur J Pediatr Surg 15(5):319–324
6. Patti MG (2001) The evolution of minimally invasive surgery: a look at the last decade. J Laparoendosc Adv Surg Tech A 11(6):325–326
7. Ndoye NA, Fall MB, Ndour O, Cissé M, Ngom G, Fall I (2013) La cœlioscopie pédiatrique au Sénégal. J Afr Fr Chir Pédiatr 0(4):199–203
8. Waldschmidt J, Schier F (1991) Laparoscopic surgery in neonates and infants. Eur J Pediatr Surg 1(3):145–150
9. Di Fabrizio D, Alizai NK, Najmaldin AS (2023) Early and long-term complications of robotic assisted laparoscopy in infants and children. J Pediatr Surg 58(9):1832–1837

Figures

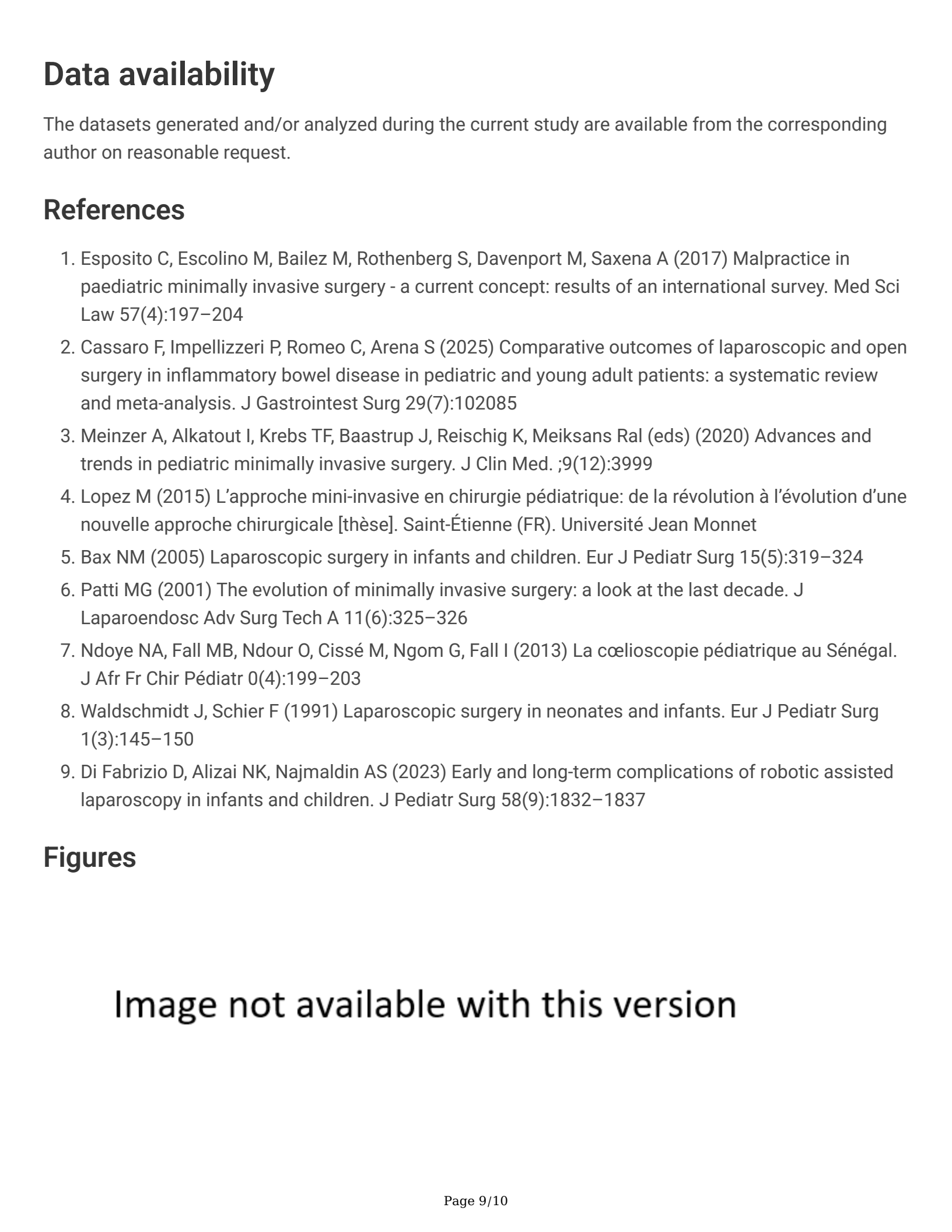


Figure 1

Legend not included with this version