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Postoperative complications of colectomy and J-pouch with ileostomy versus without ileostomy in children with inflammatory bowel diseases: a systematic review and meta-analysis

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ABSTRACT

Background The efficacy of performing a restorative proctocolectomy and J-pouch ileoanal anastomosis without diverting ileostomy in children with inflammatory bowel disease has been a longstanding debate. A systematic review and meta-analysis is presented comparing the occurrence of postoperative complications in children who underwent either the pouch-anal anastomosis (IPAA) with ileostomy (diverted) versus the undiverted procedure.

Methods Records were sourced from CINAHL, CENTRAL, EMBASE and MEDLINE databases. Studies followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines and compared postoperative complications in pediatric patients diagnosed with inflammatory diseases aged less than 18 years who underwent J-pouch with ileostomy versus without ileostomy. The primary outcome was the occurrence of postoperative leaks, and the secondary outcomes were presence of postoperative small bowel obstruction (SBO), pouchitis, stricture and fistula complications. A random-effects meta-analysis was used.

Results Twenty-three observational studies in the systematic review were included with 658 patients (83% diverted, 17% undiverted). Pooled estimates showed no difference in occurrence of leaks in children who underwent J-pouch/IPAA with ileostomy versus without (odds ratio (OR) 0.54, 95% confidence interval (CI) 0.17 to 1.64, I^2=16%). There was no difference in the occurrence of SBO, pouchitis or strictures in children who underwent J-pouch/IPAA with ileostomy versus without (SBO: OR 2.27, 95% CI 0.52 to 9.92, I^2=0%, pouchitis: OR 1.76, 95% CI 0.95 to 3.24, I^2=0%, strictures: OR 2.72, 95% CI 0.44 to 16.69, I^2=66%).

Conclusion The meta-analysis did not find differences in the occurrence of complications in pediatric patients who underwent the IPAA with ileostomy procedure versus without ileostomy.

INTRODUCTION

Inflammatory bowel disease (IBD) refers to a group of chronic, relapsing autoimmune diseases that result in chronic intestinal inflammation of both the small and large intestine. Affecting 1.5 million North Americans, the cause of this disease is not yet known but is proposed to occur as a result of inappropriate immune response to environmental factors as well as luminal and microbial antigens.[1 2] Although the onset of this disease typically manifests during adulthood, children are increasingly being diagnosed with IBD.[3]

Since 1978, the gold standard surgical treatment of ulcerative colitis (UC) is restorative proctocolectomy with ileal pouch-anal anastomosis (RP-IPAA), which can be performed via laparoscopic or open procedure, in one, two or three stages and constructed with an S-reservoir, a J-reservoir or a W-reservoir.[4] Data from Widmar *et al*[5] suggest that diversion does not prevent pouch excision and a need for long-term diversion after pouch leak in adult patients. Recently, Khalid *et al*[6] demonstrated greater probability of anastomotic strictures (odd ratio (OR) 0.40; 95% confidence interval (CI) 0.26 to 0.62, p<0.0001) and pouch failures (OR 0.54 (0.36 to 0.82), p=0.003) in adult diverted than in non-diverted patients, although reoperation was more frequently required in non-diverted patients (OR 2.51 (1.12 to 5.59), p=0.02). Hence, results are still inconclusive, debatable and rarely focus on pediatric populations with consideration of numerous postoperative complications.

Systematic reviews investigating certain postoperative complications in children who undergo diverting ileostomy procedures versus not are lacking. Moreover, differences in short-term and long-term outcomes for pediatric patients who undergo IPAA are limited owing to constraints in study design

and infrequency of IPAA in children. To address this gap, an investigation is needed comparing the frequency of postoperative complications between diverted versus undiverted IPAA procedures in a pediatric population aged less than 18 years diagnosed with IBD.

The objective of this systematic review and meta-analysis was to compare the frequency of postoperative complications in pediatric patients with IBD who have done IPAA with ileostomy (diverted) versus without ileostomy (undiverted). Secondary objectives included estimating the pooled frequency of these complications in the surgical groups.

METHODS

This review followed the Cochrane Methodology to identify and select the studies[7] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses to guide the reporting of this systematic review.[8]

Search strategy and selection criteria

A systematic search for relevant studies published between 1946 and November 4, 2019 was performed using the following databases: CINAHL (1982 onwards), CENTRAL, EMBASE (1980 onwards) and MEDLINE (1996 onwards). Twenty-two studies were included after this initial search. An update was performed in July 2021 identifying three additional eligible studies.[9–11] Searches were developed and conducted by a librarian experienced in systematic reviews, using a method designed to optimize term selection,[12] and the MEDLINE search was peer reviewed by a second librarian before being translated for the other databases. Search strategies are presented in the online supplemental file 1. The study protocol has been registered in Open Science Framework (10.31219/osf.io/svuwm). All duplicate records were removed online, records retrieved by the electronic search were downloaded and imported into a Reference Manager—a citation database, and then were uploaded to a systematic review software Covidence (www.covidence.org) for title and abstract screening and full-text review. Four reviewers (IO, MK, NT, VG) screened at title/abstract level and full-text review stages. Citations were excluded if at least two reviewers agreed to exclude. Disagreements were reviewed and were resolved by the study leads, where necessary (AN). The study co-lead (IO) reviewed all eligible citations to confirm eligibility.

Inclusion criteria

Randomized controlled trials, cohort and case–control studies examining the postoperative complications in pediatric patients diagnosed with inflammatory diseases (ie, ulcerative colitis, indeterminate colitis or unclassified IBD) aged less than 18 years who underwent J-pouch with ileostomy or without ileostomy were included. This age limit was chosen to reflect consistency with published literature on children in the field.[13–15]

Exclusion criteria

Studies were excluded if documented complications were not provided for the surgery performed or did not mention the primary endpoints of interest. Case studies, literature reviews, systematic reviews, editorials, letters to the editor, conference abstracts and commentaries were excluded, in addition to studies not written in English.

Data extraction and outcomes

Two authors (IO and NT) extracted patient frequencies using a predesigned and piloted data abstraction sheet in Excel V.14.7.7. The extracted information included study details (design, location of the study and sample size), patient demographics including age and gender, disease diagnosis, average or median follow-up, and surgical details including the procedure implemented.

The primary clinical outcome was the occurrence of anastomosis leaks. The secondary outcomes included the occurrence of small bowel obstruction, pouchitis, strictures and fistula (duodenal, enterovaginal or rectovaginal) at the designated follow-up period, as defined by the study author.

A diagnosis of stricture at the anastomosis was confirmed on examination and/or endoscopy, and anastomotic leak was defined as evidence of leak on imaging (such as pelvic fluid collection adjacent to the anastomosis) or at reoperation. Small bowel obstruction was defined by a contrast-enhanced X-ray or a CT result, demonstrating findings for obstruction, in tandem with abdominal pain, vomiting, abdominal distention, nausea, and/or decreased or absent flatus and/or stool. Late obstruction was defined as occurring after closure of the covering ileostomy. Rectovaginal fistula could have been detected on MRI, after restorative proctocolectomy. Pouchitis was primarily diagnosed clinically by symptoms of increased stool frequency, abdominal pain, and fecal incontinence and endoscopically confirmed, and was defined as inflammation in the pouch in a symptomatic patient who may have been prescribed antibiotics in the year prior to follow-up.

Assessment of risk of bias within studies

Two reviewers (NT and IO) independently reviewed each study. The validated Methodological Index for Non-Randomized Studies (MINORS) criteria were used to assess the quality of the studies.[16] Items assessed included clearly stated aims, inclusion and representativeness of patients, reliable prospective data collection, appropriate and unbiased endpoints, sufficient follow-up period, follow-up loss, adequate study size calculation, contemporary groups (to address historical bias), baseline equivalence and adequate statistical analysis.[16] Items 1 through 7 apply to non-comparative, while items 8 though 12 for comparative studies. Records were given scores of 0 through 2 for 12 criteria of bias assessment. The maximum (ideal) global score is 24 for comparative studies and is 16 for non-comparative studies.

Statistical analysis

All statistical analyses were performed using the R statistical programming language (V.4.0.3).[17] Continuous valued variables were expressed as mean±SD, and categorical variables were expressed as numbers and percentages. Inter-rater reliability was assessed between reviewers in assessing quality of the studies using weighted kappa for each of the 12 items of the MINORS scale and using a two-way model, single rater intraclass correlation coefficients (ICCs) or the total MINORS score.[18] Data were meta-analyzed using a random-effects model with R package 'meta'.[19] Pooled ORs were generated using Mantel-Haenszel test, using a random-effects model. If there were not enough studies (a minimum of two studies) to compare the two types of surgery, the proportion was pooled with a 95% CI for the complication for one type of surgical procedure using random effects. Statistical heterogeneity was determined using I^2 tests. I^2 is the proportion of total variation observed between studies attributable to differences between studies rather than sampling errors. High heterogeneity was defined as I^2 >75%.

RESULTS

Study selection

The initial search yielded 1080 studies of which 22 were originally included after full-text review. Two records were found to have patient overlap and thus were removed from the review before performing the update.[20 21] After an update was performed, there were 23 total studies that met the inclusion criteria and were included in the systematic review. Seven of these studies were used in the meta-analysis[9 11 22–26] (figure 1).

Study characteristics and individual results

Characteristics of the 23 studies with 658 patients can be found in online supplemental file 2, table S1. A total of 547 (83%) and 111 (17%) underwent IPAA with ileostomy or IPAA without ileostomy, respectively.

Of the 23 studies, the mean age of patients who underwent surgery ranged between 10.4 and 16.3 years. Based on the definition of IBD inclusion in each study, 714 (714 of 719, 99%) children presented with only clinically diagnosed UC (diagnosed via preoperative biopsies, histologic examinations of surgical specimens, endoscopy or a combined approach) or indeterminate colitis (5 of 719, 1%) diagnosed with indeterminate colitis discerned from a combination of standard laboratory tests, fecal markers of inflammation, serological biomarkers and gastrointestinal endoscopy with biopsies.[21]

There was wide variability in the percentage of females included (25%–90%). Across all studies, follow-up was at least 1 year. Of the 23 studies, 7 (32%) described conducting IPAA with ileostomy in one or two stages,[20–22 27–30] 8 (35%) in three stages,[10 31–37] and 2 (9%) in one, two or three stages.[26 38] The remaining six (26%) were not well defined.[23–25 39–41]

Of the seven studies quantifying our outcomes in the groups of IPAA with ileostomy versus without,[9 11 22–26] four (67%) reported no significant differences in preoperative characteristics among their cohorts.[22–25] Four (67%) stratified baseline characteristics, such as age, sex, duration of

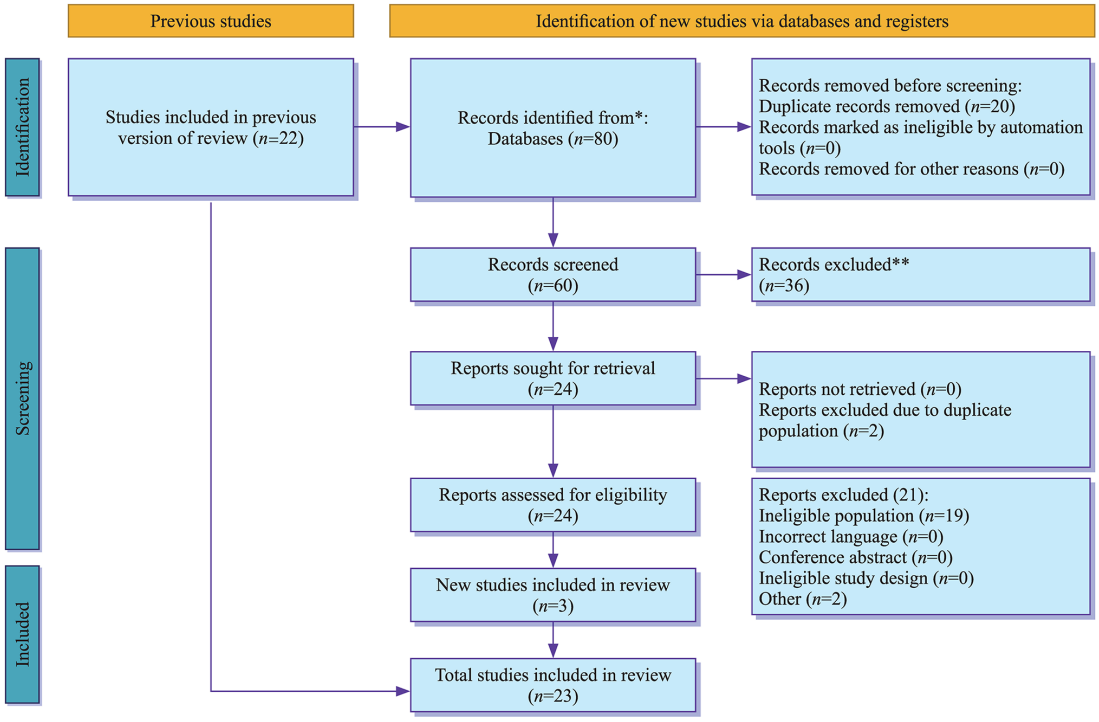

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 flow diagram for updated systematic reviews which included searches of databases and registers only.

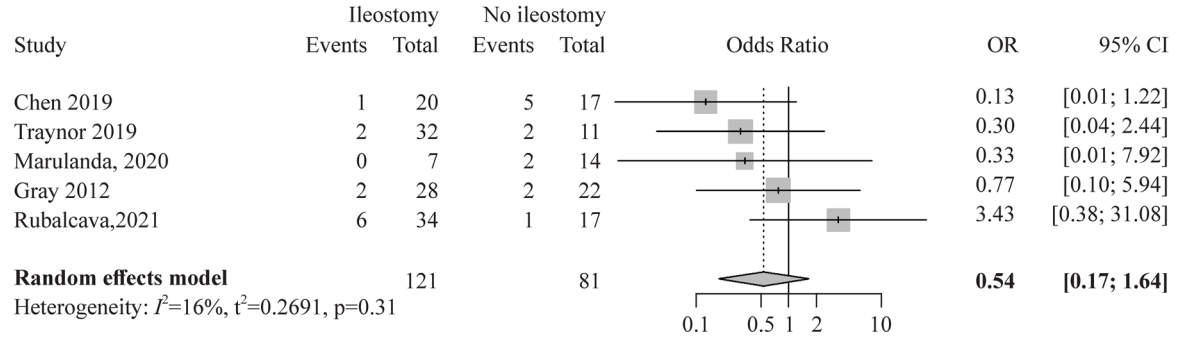

Figure 2 Meta-analysis forest plot for leaks in diverted vs undiverted ileostomy groups.

illness before resection or immunosuppression at time of surgery.[22–25] Indications for surgery included chronic anal pain and failure to achieve full continence (one study (17%))[22] and acute presentation of UC refractory to medical intervention (one (17%)).[20] One study (17%) included an urgent case in their cohort.[22]

Risk of bias across studies

Moderate agreement was achieved across the 12 items of the MINORS scale (weighted kappa 0.66, 95% CI 0.57 to 0.75 and when examining the total score for all included studies (ICC 0.68, (0.37 to 0.85)). MINORS scores for comparative studies (n=17) ranged from 17 to 20, with mean 17.4±1.5. MINORS scores for non-comparative studies (n=6) ranged from 8 to 12, with a mean of 10.1±1.5. The ideal global score is 16 for non-comparative studies and is 24 for comparative studies, which indicates fair study quality based on this definition[16] Please see online supplemental file 3 for the methodological appraisal of observational studies (online supplemental table S2).

Primary analysis outcome

Leaks

There were five comparative studies that reported on leaks.[9 11 23 25 26] The pooled estimate showed no difference in postoperative risk of leaks among patients who underwent the J-pouch with ileostomy procedure as compared with patients with J-pouch without ileostomy (OR 0.54, 95% CI 0.17 to 1.64, I^2=16%) (figure 2).

Secondary analysis outcomes

Small bowel obstruction

Three studies were included in the pooled meta-analysis for the complication of small bowel obstruction.[9 23 25] The pooled estimate indicated no difference in the odds of small bowel obstruction in children with ileostomy versus without (OR 2.27, 95% CI 0.52 to 9.92, I^2=0%) (figure 3A).

Pouchitis

There were six relevant studies included in the pooled meta-analysis,[9 11 22–25] the pooled estimate suggested no difference in patients with J-pouch and ileostomy developing pouchitis compared with patients without ileostomy (OR 1.76, 95% CI 0.951 to 3.24, I^2=0%) (figure 3B).

Strictures

There were two studies that reported on strictures in J-pouch with ileostomy versus without. The pooled estimate showed no difference in risk of strictures between patients with J-pouch with ileostomy versus without (OR 2.72; 95% CI 0.44 to 16.69, I^2=66%) (figure 3C).

Fistula

None of the included studies compared the occurrence of fistula between the two surgery types; nor was fistula reported across the studies for pediatric patients without ileostomy. Therefore, the proportion of fistula complication was pooled only in pediatric patients who underwent J-pouch with ileostomy.[10 30 32 34 38] Pooled prevalence of fistula in these patients was 2.0% (95% CI 0.0% to 4.0%, I^2=0%) (figure 4).

DISCUSSION

This systematic review included 23 studies (658 patients), among which 7 studies quantified complications of interest between the J-pouch/IPAA with ileostomy procedure versus without. Results from the meta-analysis demonstrated that there is no difference in postoperative complications, specifically anastomotic leaks, when comparing pediatric patients with J-pouch with ileostomy versus patients with J-pouch without ileostomy. Avoiding a diverting ileostomy in select patients could be a safe alternative because there is no evidence of a protective benefit against leaks when using a diverting ileostomy. The majority of studies had small sample sizes, with CIs overlapping one, which reduces statistical confidence in the findings. In the adult literature, anastomotic leak rates range from 5% to 19%,[42–44] and there seems to be a trend towards decreased clinically detectable leak rates in the diverted versus undiverted group.[23] This finding does not align with previous literature reporting higher incidence of anastomotic leakage in the undiverted than diverted populations.[42 45–48]

No statistical difference was found in small bowel obstruction in diverted versus undiverted pediatric patients, which contrasts with prior literature. Although the target populations differ, one study of a clinical sample of adults showed significantly higher odds of small bowel obstruction in diverted patients (OR 5.05 (1.35 to 18.92))

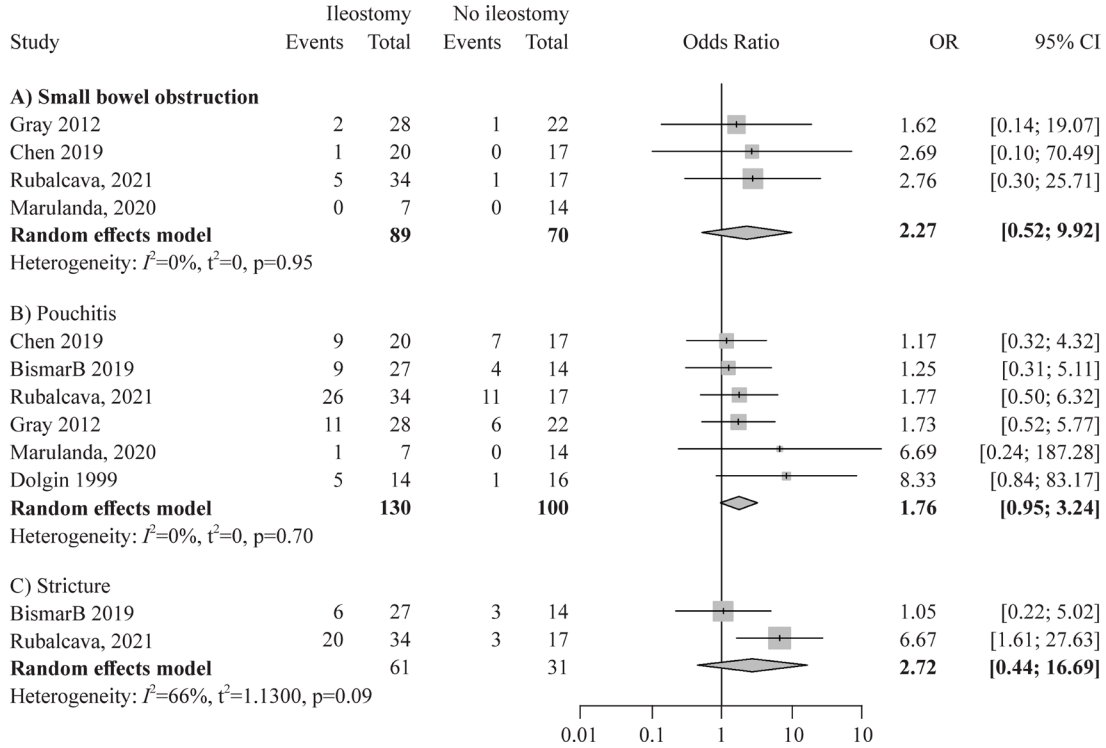

Figure 3 (A) Meta-analysis forest plot for secondary outcome complications in diverted vs undiverted ileostomy groups for small bowel obstruction. (B) Meta-analysis forest plot for secondary outcome complications in diverted vs undiverted ileostomy groups for pouchitis. (C) Meta-analysis forest plot for secondary outcome complications in diverted vs undiverted ileostomy groups for stricture.

than undiverted patients after adjusting for steroid use, age, length of follow-up, prior subtotal colectomy and primary preoperative diagnosis.[49–53] Moreover, restorative proctocolectomy requires extensive bowel manipulation and pelvis dissection, and manipulating the small bowel for ileostomy might increase the incidence of clinically distinguished small bowel obstruction.[53–57] Additionally, small bowel obstruction resulting from an abscess is a prevalent complication after proctocolectomy and ileo-anal anastomosis.[58]

The meta-analysis did not find evidence of increased odds of pouchitis in children who underwent J-pouch/IPAA with ileostomy versus without ileostomy, given that the CIs overlapped one due to small sample sizes. This finding suggests non-inferiority of the diverting ileostomy approach. Larger sample size studies are warranted. Pouchitis is the most prevalent long-term complication in patients who undergo IPAA. Sixty per cent of affected children suffer from recurrent episodes and 5%–10% can develop chronic pouchitis.[59 60] Pouchitis can develop in 80% of adult patients after RP-IPAA, significantly impairing quality of life.[61 62] Literature suggests similar pouchitis rates between diverted versus undiverted groups, likely due to comparable operative techniques for building the IPAA. In fact, Dolgin *et al*[24] reported no significant difference between the J-pouch and ileostomy versus without ileostomy procedures, in terms of complications or functional outcomes and no patient developed a significant pouch complication in either group. Hence, the diverting stoma did not affect pouchitis occurrence,[22] although one study suggests that creating a diverting ileostomy could avoid consequences of pouch leak or failure by enabling recovery of anal sphincter function.[45] Pouchitis may occur more frequently in IPAA with

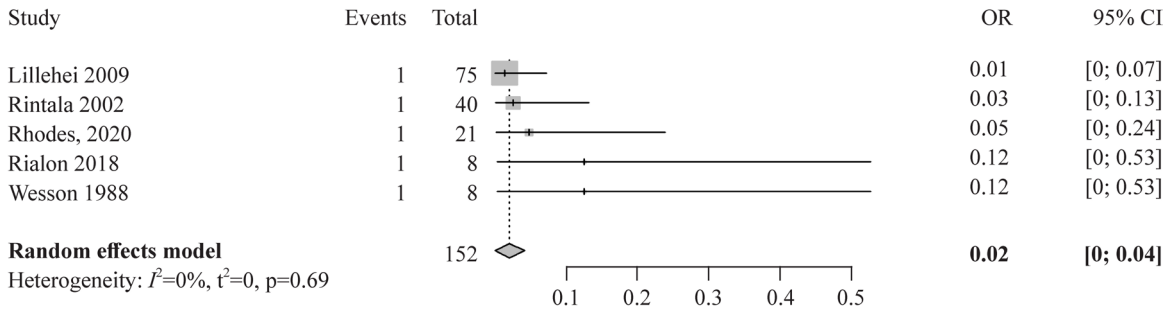

Figure 4 Forest plot for the proportion of fistula complication in patients with J-pouch with ileostomy.

ileostomy patients owing to inflammatory stasis within the reservoir, particularly from larger reservoirs, which empty only partially during defecation.[63]

Among the two studies reporting strictures, the pooled estimate showed no difference in risk of strictures between patients with J-pouch with ileostomy versus without.[9 22] Similarly, previous literature reports comparable frequencies in anastomotic strictures between undiverted versus diverted groups because pouch anastomosis leaks can resolve without significantly contributing to symptoms, resulting from dilatation treatment. Despite this, Gawad *et al*[64] and other authors propose that residual, active disease at the ileoanal anastomosis site could still compromise healing, and the extent of inflammation in resected surgical specimens predicts pouch-related complications, such as anastomotic stricture and leaks post-IPAA.[20 65]

In this review, the percentage of fistula in pediatric patients who underwent J-pouch with ileostomy was low (at 2%). This aligns with previous literature indicating low prevalence of fistula in children with familial adenomatous polyposis (FAP) and UC postoperation for J-pouch.[66 67]

Limitations

Overall, the biggest limitations include: (1) lack of consistent outcome reporting; (2) lack of studies comparing the two surgical approaches for pooled analysis and (3) lack of data on other confounding risk factors (including age, body mass index (BMI), case urgency, nutritional status, etc). Addressing each of these concerns would enable direct comparison between the defined outcomes based on clinical factors. Second, the estimates collected in this systematic review are based on observational studies and not on randomized controlled trials. However, randomizing by surgery type is a difficult approach, and only one study has randomized by diversion.[68] Lastly, surgeons may have a clinical preference towards undiverted surgery in patients who are 'healthier' (ie, lack of anastomosis tension, good pelvic dissection, nutritional status and decreased immunosuppressant doses)[5] because an undiverted pouch can have more favorable preoperative and operative characteristics and because diversion does not always prevent pouch excision.[5 25 69 70] This potential preference might explain why there were so few studies comparing the outcomes directly between IPAA diverted versus undiverted ileostomy procedures.

In conclusion, this meta-analysis suggests no difference in the number of anastomotic leaks, or in small bowel obstruction, pouchitis and stricture in IPAA with ileostomy versus no ileostomy. Future studies are encouraged to report short-term and long-term outcomes consistently for pouch surgery so that pooled analyses can be performed. In particular, a future investigation of leaks, strictures, long-term function, acute and chronic pouchitis, and level of intervention to control these complications, including antibiotics, immunotherapy or pouch excision, is warranted. If sample size permits, studies are encouraged to stratify their outcomes by diversion status as well as IBD type to identify specific differences in complications among children. Because the presence of intestinal occlusions could be highly correlated in IPAA with ileostomy from adhesions,[54 71] capturing adhesions data in a subsequent review is recommended. Finally, standard preoperative health criteria for choosing undiverted or diverted procedures should be developed to optimize surgery selection for children with IBDs.

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Supplementary File 1

Search Strategies

j pouch and Colectomy multifile
1. (Colitis, Ulcerative/ or (ulcerative or colitis).ti,ab,kf.) and (Proctocolectomy, Restorative/ or Colonic Pouches/ or (j pouch* or jpouch* or ilea* pouch* or ipaa).ti,ab,kf.)
2. 1 and (protective or temporary or ileostomy).ti,ab,kf. and (english or french or arabic).lg.
3. limit 2 to (case reports or editorial)
4. 2 not 3
5. (exp ulcerative colitis/ or (ulcerative or colitis).ti,ab,kw.) and (Proctocolectomy, Restorative/ or Colonic Pouches/ or (j pouch* or jpouch* or ilea* pouch* or ipaa).ti,ab,kw.)
6. 5 and (protective or temporary or ileostomy).ti,ab,kw. and (english or french or arabic).lg.
7. limit 6 to embase
8. ((ulcerative or colitis) and (proctocolect* or colonic pouch* or j pouch* or jpouch* or ilea* pouch* or ipaa) and (protective or temporary or ileostomy)).ti,ab,kw.
9. 4 use medall
10. 7 use emczd
11. 8 use cctr
12. or/9-11

Supplementary File 2

Table S1. Summary of study characteristics of records included in the systematic review

Patients or population: Children with inflammatory bowel diseases
Settings: Inpatient
Intervention: IPAA/J pouch with ileostomy (diverted)
Comparison: IPAA/J pouch without ileostomy (undiverted)

Study	Study design	Center(s)	Years studied	Population	Intervention /comparison group(s) (n)	Age, years (mean/median)	% female	Outcome measure(s)	Median/mean follow-up (years)
Barrena et al., 2011	Retrospective cohort	1	1992-2009	All UC children who underwent RPCIA[a] with or without pouch	RPCIA with pouch (12) RPCIA without pouch (16)	UC: 11	Not specified	Pouchitis; stools/day; daytime continence; nocturnal leaks	UC: 12
BismarB et al., 2019	Retrospective cohort	1	2004-2017	All UC children who underwent a two-stage laparoscopic restorative proctocolectomy and IPAA	TIPAA[c] (27) NIPAA[d] (14)	14	48.8	Appetite recovery; continence; pouchitis; prescribed antidiarrheals	0.2
Chen et al., 2019	Retrospective cohort	Multi-institutional (unspecified)	2008-2016	All UC children who underwent an initial STC-I[e] followed by CP-IPAA[f] with and without diverting ileostomy	Diverted pouch (20) Undiverted pouch (17)	16	41.0	30-day complication rate; anastomotic leak; readmission rate; reoperation; functional pouch outcome; length of hospital stay	2.1

Chew et al., 2003	Retrospective case-control	1	1987-2001	All UC children with initial colectomy, ileostomy and mucous fistula followed by an ileal J pouch	IPAA in pediatric patients (16)	12	44.0	Bowel frequency per week; bowel frequency during the day; continence; small bowel obstruction; pouchitis	Children: 8.6
Dolgin 1999	Retrospective case-control	1	1991-2007	All UC children who underwent reconstruction with rectal mucosectomy and hand-sewn ileoanal anastomosis to a J pouch	Group 1: Temporary diverting ileostomy (14) Group 2: Absence of diverting ileostomy (16)	Group 1: 13.8 Group 2: 10.4	Group 1: 71.4 Group 2: 62.5	Average bowel movements; nighttime staining; daytime staining; post-operative complications; small bowel obstruction; pouchitis; anastomotic leak	4.4
Gray et al., 2012	Retrospective case-control	1	2002-2010	All UC children who underwent restorative proctocolectomy and IPAA with or without ileostomy	IPAA with ileostomy (28) IPAA without ileostomy (22)	Ileostomy group: 14.3 No ileostomy group: 13.5	Not specified	Ileoanal anastomotic dilations; anastomotic stricture; pouchitis; small bowel obstruction; daily bowel movements; stool incontinence; nighttime soiling	Ileostomy group: 2.4 No ileostomy group: 1.9
Huntington et al., 2016	Retrospective cohort	1	2006-2014	All UC children who underwent IPAA and ileostomy takedown	MIS IPAA with RE[g] (22) Open IPAA without RE[h] (8)	MIS/RE: 13.7 Open/no RE: 13.4	MIS/RE: 36 Open/no RE: 37.5	Number of stools per day; percentage of patients stooling at night; percentage of patients with	1

								soiling; percentage of patients with stool altering medications; pouchitis	
Lawal et al., 2011	Retrospective cohort	1	2001-2009	All UC children who underwent an IPAA and pouchogram	IPAA (26)	13.8	62.1	Stricture; leak; pouchitis; pelvic abscess	1.1
Lillehei et al., 2009	Retrospective cohort	1	1987-2006	All UC children who underwent RP with IPAA or distal rectal mucosectomy and IPAA	Total abdominal colectomy followed by distal rectal mucosectomy and IPAA (75) RP with IPAA[i] (25)	13.2	52	Daytime fecal continence; nighttime continence; average frequency of bowel movements; pouchitis; ileoanal stricture	2.6
Mattioli et al., 2012	Prospective cohort	1	2006-2011	All UC children who underwent laparoscopic ileo J pouch low rectal anastomosis	Laparoscopic ileo J pouch low rectal anastomosis (17)	12	90	Bowel obstruction; fistula; pouchitis; ileostomy prolapse; anastomotic stricture	2
Motta et al., 1992	Retrospective cohort	1	1988-1990	All UC children who underwent the J pouch Swenson procedure	Three stage procedure in children with UC (3)	14.2	80	Small bowel obstruction; pouchitis; pelvic abscess; fistula; stricture	1.1
Pellino et al., 2014	Prospective case-control	1	2007-2012	All UC children with IPAA	UC children with restorative	12	58.3	Recurrence; pouchitis; stool frequency per day;	1

					proctocolectomy with IPAA (12)			urgency; night evacuation	
Rialon et al., 2018	Retrospective cohort	1	2000-2015	All very early-onset colitis children who underwent subtotal colectomy with end ileostomy	UC children with subtotal colectomy and end ileostomy needing J pouch (14)	7.4	52	Pouchitis; fistula; pouch ulcerations;	7.1
Rinawi et al., 2017	Retrospective cohort	1	1981-2013	All UC children who underwent colectomy and IPAA	UC children who underwent colectomy with IPAA (two or three-stage operation) (33)	16.3	25	Recurrence; pouchitis; duration between IPAA and first pouchitis episode	7.6
Rintala et al., 2002	Retrospective cohort	1	1991-1999	All UC children who underwent proctocolectomy and J pouch IPAA	Proctocolectomy and J pouch IPAA performed in one-stage (29)	UC: 13	37.5	Small bowel obstruction; recurrence; fistula; pouchitis; continence; bowel frequency	4
Saklani et al., 2011	Retrospective cohort	1	1995-2006	All UC children who underwent restorative proctocolectomy and a stapled ileoanal	Stapled ileoanal anastomosis with J pouch (10)	15	28.6	Small bowel obstruction; recurrence; pouchitis; daytime and nocturnal stool frequencies; permanent stoma	5.5

				anastomosis with J pouch					
Sarigol et al., 1996	Retrospective cohort	1	1982-1992	All UC children who underwent colectomy and ileal pouch-anal anastomosis (IPAA)	Subtotal colectomy with ileostomy or proctocolectomy with a J pouch (51)	14.2	52.7	Small bowel obstruction; recurrence; pouchitis; reoperation; perineal infection; anastomotic stricture	1.9
Teitelbaum et al., 2001	Retrospective case-series	1	1998-1999	All UC children who underwent laparoscopy-assisted proctocolectomy and IPAA with ileostomy	UC children who underwent laparoscopy-assisted proctocolectomy and IPAA with ileostomy (7)	10.3	71.4	Small bowel obstruction; recurrence; time to enteral feedings; postoperative intravenous narcotics	Unspecified
Traynor et al., 2019	Retrospective cohort	2	2007-2018	All UC children who underwent IPAA (1-stage, traditional 2-stage, modified 2-stage, or 3-stage)	Diverted ileostomy at IPAA creation (75) Undiverted (18)	15	57	Bowel obstruction; dehydration; anastomotic leak; gastrointestinal bleeding; readmission	Unspecified
Wesson et al., 1998	Retrospective case series	1	1983-1985	All UC children who underwent mucosal proctectomy with J pouch construction	Mucosal proctectomy with J pouch and ileostomy (5)	11	37.5	Small bowel obstruction; pouchitis; fistula; prolapse; partial dehiscence; stool frequency	0.75

				and ileostomy					
Marulanda et al., 2020	Retrospective cohort	1	2014-2020	All UC children who underwent elective or urgent-staged restorative proctocolectomy with IPAA	32 staged IPAA; 7 traditional two-stage, 14 modified two-stage, and 11 three-staged IPAAs	14.3	56.3	Anastomotic leak; pouchitis; small bowel obstruction; urinary retention; dehydration; urinary tract infection	Unspecified
Rhodes & Cusick 2020	Retrospective cohort	1	1995-2014	All pediatric patients who underwent three-staged procedure including subtotal colectomy with ileostomy, restorative surgery with ileal pouch-anal anastomosis, and ileostomy closure	21 patients with J-pouch formation	12	59	Small bowel obstruction; anastomotic leak; pouch-vaginal fistula	1-2
Rubalcava et al., 2021	Retrospective cohort	1	2010-2019	All pediatric patients with biopsy-proven UC who underwent	Modified 2-stage (17) Traditional 2-stage (34)	13	46	Small bowel obstruction; anastomotic leak; acute pouchitis; stricture	4.3

	modified 2-stage restorative proctocolectomy/IPAA and matched with UC patients who received traditional 2-stage operation

[a]Restorative proctocolectomy and ileoanostomy (RPCIA)
[b]Laparoscopic restorative proctocolectomy and ileal pouch-anal anastomosis (RS-IPAA)
[c]Traditional laparoscopic ileal pouch-anal anastomosis with protective loop ileostomy (TIPAA)
[d]Non-traditional completion ileal pouch-anal anastomosis without a stoma (NIPAA)
[e]Subtotal colectomy and end ileostomy (STC-I)
[f]proctectomy with creation of an ileal-pouch anal anastomosis (CP-IPAA)
[g]Minimally invasive ileal pouch-anal anastomosis with rectal eversion (MIS IPAA with RE)
[h]Open IPAA without rectal eversion (RE)
[i]Restorative proctocolectomy with ileal pouch-anal anastomosis (RP with IPAA)
[j] Staged laparoscopic subtotal colectomy (LSTC) followed by J pouch ileorectal anastomosis (JPIRA)

Supplementary File 3

Table S2. Methodological appraisal of observational studies

	Criteria												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Studies	Clear aim	Inclusion of consecutive patients	Prospective data collection	Endpoints appropriate to the aim	Unbiased assessment of the endpoint	Follow-up period appropriate (minimum 2 years)	Follow-up loss less than 5%	Prospective calculation of the study size	Adequate control group	Contemporary groups	Baseline equivalence of groups	Adequate statistical analysis	Total
Barrena et al 2011[1]	2	1	1	2	0**	2	0	1	2	2	1	1	15
BismarB et al 2019 [2]	2	1	2	2	0	1	0	1	2	2	2	2	17
Chen et al 2019 [3]	2	2	2	2	0	2	0	1	2	2	2	2	19
Chew et al 2003 [4]	2	2	2	2	0	2	1***	1	2	2	1	2	19
Dolgin et al 1999 [5]	2	2	1	2	0	2	0	1	2	2	2	2	18
Gray et al 2012 [6]	2	2	1	2	0	2	0	1	2	2	2	2	18
Huntington et al 2016 [7]	2	2	2	2	0	1	0	1	2	2	2	1*	17
Lawal et al 2011 [8]	2	2	2	2	0	2	0	1	0	0	0	0	11

Lillehei et al 2009 [9]	2	2	2	2	1	2	0	1	2	1****	1	2	18
Mattioli et al 2012 [10]	2	2	1	2	0	2	0	1	0	0	0	0	10
Motta et al 1992 [11]	1*****	1	1	2	0	2	2	1	2	2	1	1	16
Pellino et al 2014 [12]	2	1	2	2	0	1	0	1	2	1	2	2	16
Rialon et al 2018 [13]	2	2	2	2	0	1**	0	1	2	2	1	1	16
Rinawi et al 2017 [14]	2	1	1	2	0	2	0	1	2	2	2	2	17
Rintala et al 2002 [15]	2	2	1	2	0	2	0	1	2	2	0******	1*	15
Saklani et al 2011 [16]	2	1	1	2	0	2	2	1	0	0	0	0	11
Sarigol et al 1996 [17]	2	1	1	2	0	1	0**	1	0	0	0	0	8
Teitelbaum et al 2001 [18]	1	1	1	1	0	2	2	1	2	2	1	2	16
Traynor et al 2019 [19]	2	1	2	2	0	2	2	1	2	2	2	2	20
Wesson et al 1988 [20]	2	2	1	2	0	2	2	1	0	0	0	0	12
Rubalcava et al 2021[21]	2	2	2	2	0	2	0	1	2	2	2	2	19
Rhodes et al 2020[22]	2	0	1	2	0	2	2	0	0	0	0	0	9

Marulanda et al 2020[23]	2	1	2	2	0	2	2	1	2	2	1	2	19

Note: Items 1 through 7 are for non-comparative, while 8 through 12 are for comparative studies
*Provide results but do not describe statistical tests performed
**Absence or imprecision of the information available (e.g., no description of blinding procedures)
***Loss to follow-up exceeding 5%
****Possible historical bias, unclear identical study capture period for groups
*****Unclear aim
******Groups differ on age and sex at baseline

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