Ileum vs Colon for Neobladder Reconstruction After Radical Cystectomy: A Systematic Review and Meta-Analysis

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Purpose: This study aimed to compare and evaluate the functional outcomes and safety of ileal neobladder and colonic neobladder (sigmoid and ileocecal subtypes) after radical cystectomy.

Materials and Methods: A systematic literature search was conducted across PubMed, Web of Science, and Embase following the PRISMA 2020 guidelines. Subgroup analyses compared ileal neobladder with sigmoid neobladder and ileocecal neobladder. Study quality was evaluated using the Cochrane Risk of Bias 2 tool and Newcastle-Ottawa Scale, and evidence certainty was evaluated using the GRADE approach. Continuous and dichotomous variables were analyzed using weighted mean differences and risk ratios with 95% confidence intervals.

Results: Seventeen studies (one randomized controlled trial and 16 cohort studies) were included. Early postoperative complications were significantly less frequent with ileal neobladder than with sigmoid neobladder, with no significant difference between ileal and ileocecal neobladders. Late complications and daytime continence were comparable among all groups. Ileal neobladder achieved significantly superior nighttime continence compared with colonic neobladders. However, ileal neobladder was associated with higher postvoid residual urine volume and higher clean intermittent catheterization rates than sigmoid neobladder, with similar voiding outcomes between ileal and ileocecal neobladders.

Conclusion: Ileal neobladder provides superior nighttime urinary continence and lower early complication rates compared with sigmoid neobladder, whereas sigmoid neobladder provides better spontaneous voiding performance. Given the observational nature of available evidence and notable heterogeneity, no single pouch type is universally superior, and individualized surgical selection is recommended.

Keywords: urinary bladder neoplasms; colonic pouches; ileal neobladder; cystectomy; meta-analysis

INTRODUCTION

Bladder cancer is the most prevalent malignancy of the urinary tract and one of the most common cancers worldwide.[12,40] It is broadly categorized into non-muscle-invasive and muscle-invasive disease.[6,10,11] For muscle-invasive bladder cancer, radical cystectomy (RC) is the standard surgical treatment.[4,27,36] Following RC, creation of an orthotopic neobladder (NB) closely reconstructs the anatomical position and function of the native bladder.[38] While not the most frequently performed diversion, it offers the closest approximation to physiological lower urinary tract anatomy. The primary objective of an NB is to restore urinary function, allowing volitional urethral micturition without an external appliance.[41] Avoidance of a cutaneous stoma and preservation of spontaneous voiding represent major advantages of orthotopic reconstruction over noncontinent urinary conduits,[3,15,21,35] significantly preserving patient quality of life.

To date, orthotopic neobladders can generally be categorized into two main types: ileal neobladder (INB) and colonic neobladder (CNB).[8,24,37] Regarding INB, its widespread adoption as a bladder substitute stems from its favorable performance in continence preservation. However, it exhibits drawbacks such as substantial postvoid residual urine volumes, a frequent requirement for clean intermittent catheterization, and potential metabolic and electrolyte disturbances. These limitations position CNB as a strong alternative. CNBs typically demonstrate favorable spontaneous emptying capacity and structural durability. Nevertheless, they may carry an increased risk of specific operative complications and bowel dysfunction, including chronic alterations in bowel habits that can adversely affect a patient's daily life.[16,18-20,28,30,42,46]

At present, the question of which neobladder type provides superior long-term clinical and functional outcomes remains contentious.[23] Because each bowel segment possesses distinct urodynamic, contractile, and absorptive characteristics, selecting the optimal substitute is clinically crucial. This decision is particularly vital in younger, active patients who require durable functional outcomes. Therefore, we performed this systematic review and meta-analysis to compare functional outcomes and safety profiles between ileal and colonic bowel segments. This study synthesizes all comparative evidence published since 1999 concerning the functional outcomes and complications of INB and CNB. To provide a more granular evaluation, we further stratified colonic reservoirs into sigmoid neobladder (SNB) and ileocecal neobladder (ICNB).[25]

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Table 1. Characteristics and quality ratings of included comparative studies evaluating orthotopic neobladder reconstruction

Study	Year	Country	Study Design	Comparison Groups	Sample Size (n)	Quality Rating / NOS Scoreb
Santucci et al.(37)	1999	USA	Retrospective cohort	INB vs SNB vs ICNB	48	7
Bassiouny et al.(5)	2004	Egypt	Retrospective cohort	INB vs SNB	60	7
Schrier et al.(39)	2005	Netherlands	Retrospective cohort	INB vs SNB	35	8
Khafagy et al.(25)	2006	Egypt	Retrospective cohort	INB vs ICNB	80	8
Koraitim et al.(26)	2006	Egypt	Retrospective cohort	INB vs SNB vs ICNB	88	7
Kato et al.(23)	2007	Japan	Retrospective cohort	INB vs SNB	54	7
Miyake et al.(33)	2008	Japan	Retrospective cohort	INB vs SNB vs ICNB	108	8
Chen et al.(9)	2009	China	Randomized controlled trial	INB vs ICNB	71	Low riskc
El Baz et al.(14)	2009	Egypt	Retrospective cohort	INB vs SNB	40	7
Honeck et al.(22)	2009	Germany	Retrospective cohort	INB vs SNB	45	8
Miyake et al.(31)	2012	Japan	Retrospective cohort	INB vs SNB	70	8
Guan et al.(16)	2013	China	Retrospective cohort	INB vs SNB	65	7
Miyake et al.(32)	2013	Japan	Retrospective cohort	INB vs SNB	82	8
Paananen et al.(34)	2014	Finland	Prospective cohort	INB vs SNB vs ICNB	78	8
El-Helaly et al.(13)	2019	Egypt	Retrospective cohort	INB vs SNB	52	8
Kulkarni et al.(28)	2003	India	Retrospective cohort	INB vs SNB	95	7
Crivellaro et al.(48)	2009	Italy	Retrospective cohort	INB vs SNB vs ICNB	30	7

Abbreviations: ICNB, ileocecal neobladder; INB, ileal neobladder; NOS, Newcastle-Ottawa Scale; SNB, sigmoid neobladder.
a Reference markers correspond to numbered citations in the reference list.
b Newcastle-Ottawa Scale total score ranges from 0 to 9 stars; higher scores indicate greater methodological quality.
c Evaluated using the Cochrane Risk of Bias 2 (RoB 2) tool for randomized controlled trials.

MATERIALS AND METHODS

Inclusion and Exclusion Criteria

Studies were considered eligible for inclusion if they satisfied the following predefined criteria:

Inclusion Criteria:

1. Comparative clinical studies evaluating functional outcomes and postoperative complications in adult patients undergoing RC and orthotopic neobladder reconstruction using either ileal or colonic bowel segments, including subdivisions into sigmoid and ileocecal reservoirs.
2. Studies reporting comprehensive evaluations of functional outcomes related to urinary storage, voiding efficiency, urodynamic parameters, or surgical safety profiles.

Exclusion Criteria:

1. Animal, cadaveric, or basic laboratory experimental investigations.
2. Non-English-language publications.
3. Studies reporting the use of ileal or colonic segments for ureteral substitution, bladder augmentation (cystoplasty), or non-bladder urinary diversions.
4. Non-comparative single-arm cohort series describing only a single intestinal pouch type.
5. Review articles, narrative commentaries, letters, editorials, guidelines, and single case reports.

Search Strategy

We conducted a comprehensive literature search across PubMed (n = 372), Web of Science (n = 71), and Embase (n = 178) to identify comparative studies investigating ileal versus colonic orthotopic neobladder reconstruction after RC. The core search string combined Boolean logic as follows: ((neobladder) OR (bladder replacement) OR (bladder reconstruction)) AND ((ileum) AND (colon) OR (ileum) AND (sigmoid) OR (ileum) AND (ileocecum)). Search terms were tailored to the syntax requirements of each database.
The database searches were updated to cover the most recent 14 months, with the final search cutoff date established as June 29, 2026. Only English-language full-text articles were considered to maintain consistent data extraction standards. Duplicate publications were identified and removed using reference management software and manual deduplication. Two independent reviewers performed initial screening of titles and abstracts, followed by independent full-text assessment according to the predefined eligibility criteria. Discrepancies were resolved through consensus discussion, and unresolved disagreements were adjudicated by a senior third reviewer to guarantee consistency.
Grey literature and reference screening: Reference lists of all eligible articles and relevant systematic reviews were scrutinized manually. Conference abstracts, academic dissertations, and unpublished grey literature were not included.
PROSPERO registration: This systematic review protocol was prospectively registered on the PROSPERO database (registration number CRD42023463061). Minor protocol amendments concerning updated search dates and clarified endpoints were documented within the registry.
A completed PRISMA 2020 checklist with cross-references to corresponding manuscript sections is provided in **Supplementary File S1**.

Data Extraction

Data extraction was independently conducted by two investigators using standardized forms. The extracted parameters included: first author's surname; publication year; country of study origin; type of intestinal segments utilized (ileum, sigmoid colon, or ileocecal segment); sample sizes of the respective reconstruction arms; baseline patient demographics (mean or median age); and follow-up duration. Functional and clinical endpoints included early and late postoperative complications; daytime and nighttime urinary continence rates; maximum bladder capacity; postvoid residual urine volume; and clean intermittent catheterization (CIC) dependency rates.

Risk of Bias Assessment

Table 2. GRADE evidence profile for all pooled analyses comparing ileal and colonic orthotopic neobladder reconstruction

Outcome	Study Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Overall Certainty
Daytime continence	14 observational cohorts; 1 RCT	Serious residual confounding; downgrade 1 level[a]	Moderate heterogeneity (I^2 = 41%); downgrade 1 level[b]	No indirectness	Narrow 95% CIs, adequate sample size	Egger's test *P* = .003; downgrade 1 level	Low
Nighttime continence	14 observational cohorts; 1 RCT	Serious residual confounding; downgrade 1 level[a]	Substantial heterogeneity (I^2 = 57%); downgrade 1 level[b]	No indirectness	Narrow 95% CIs	Egger's test *P* = .033; suspected bias	Low
Maximum bladder capacity	8 observational cohorts	Serious residual confounding; downgrade 1 level[a]	Very high heterogeneity (I^2 = 97%); downgrade 1 level[b]	No indirectness	Limited number of studies, wide 95% CIs; downgrade 1 level[c]	<10 studies, unassessable	Low
Postvoid residual	10 observational cohorts	Serious residual confounding; downgrade 1 level[a]	High heterogeneity (I^2 = 84%); downgrade 1 level[b]	No indirectness	Acceptable sample size	Funnel plot detected volume no obvious bias (no downgrade)[d]	Moderate
CIC utilization rate	6 observational cohorts	Serious residual confounding; downgrade 1 level[a]	No heterogeneity (I^2 = 0%)	No indirectness	Few included studies, wide 95% CIs; downgrade 1 level[c]	<10 studies, unassessable	Low
Early postoperative complications	6 observational cohorts	Serious residual confounding; downgrade 1 level[a]	No heterogeneity (I^2 = 0%)	No indirectness	Limited study quantity, wide 95% CIs; downgrade 1 level[c]	<10 studies, unassessable	Low
Late postoperative complications	6 observational cohorts	Serious residual confounding; downgrade 1 level[a]	No heterogeneity (I^2 = 0%)	No indirectness	Few studies, wide 95% CIs; downgrade 1 level[c]	<10 studies, unassessable	Low

Abbreviations: CI, confidence interval; CIC, clean intermittent catheterization; GRADE, Grading of Recommendations Assessment, Development and Evaluation; RCT, randomized controlled trial.

[a] All primary observational studies reported unadjusted crude outcome data without uniform multivariable correction for clinical confounders, leading to a one-level downgrade in evidence certainty.

[b] Evidence certainty was downgraded by one level when inter-study heterogeneity was substantial ($I^2 > 50\%$).

[c] Evidence was downgraded for imprecision when few eligible studies or broad 95% confidence intervals were present.

[d] Formal publication bias testing was conducted for outcomes with ≥ 10 studies; no small-study effect was observed via funnel plot inspection and statistical tests.

Two independent investigators assessed the methodological quality of all included studies, with consensus adjudication by a third senior investigator when necessary. The single randomized controlled trial was evaluated using the Cochrane Risk of Bias 2 (RoB 2) tool; this trial demonstrated an overall low risk of bias, with unclear risk restricted to the allocation concealment domain. All 16 observational cohort studies were appraised using the Newcastle-Ottawa Scale (NOS, range 0–9 stars). Studies achieving 7 to 9 stars were considered high quality, whereas those scoring 5 to 6 stars were categorized as moderate quality. NOS quality scores for each study are presented in **Table 1**.

PICO Framework

Population: Adult patients with bladder cancer undergoing radical cystectomy and orthotopic intestinal neobladder reconstruction.
Intervention: Ileal neobladder (INB).
Comparators: Sigmoid neobladder (SNB) and ileocecal neobladder (ICNB).
Primary outcomes: Daytime urinary continence, nighttime urinary continence, and postvoid residual volume.
Secondary outcomes: Maximum bladder capacity, clean intermittent catheterization (CIC) rate, and early and late postoperative complications.

Statistical Analysis

All meta-analyses were executed using Review Manager (RevMan version 5.3; The Nordic Cochrane Centre, Copenhagen, Denmark) and STATA (version 18.0; StataCorp, College Station, TX, USA). Between-study heterogeneity was evaluated using the I^2 statistic and Chi-square test. If I^2 exceeded 50%, indicating substantial heterogeneity, a random-effects model was applied; otherwise, a fixed-effect model was used. Dichotomous variables were summarized using risk ratios (RRs) and 95% confidence intervals (CIs). Continuous variables were analyzed using weighted mean differences (WMDs) with corresponding 95% CIs.

All pooled outcomes in this meta-analysis represent crude unadjusted estimates because original observational studies rarely reported uniform multivariable-adjusted hazard or risk estimates across comparable covariates. Confounding adjustment profiles for each included study are summarized in **Table 1** and detailed in **Supplementary Table S1**. Primary clinical confounders encompassed patient age, tumor stage, baseline renal function, performance status, surgical volume, and follow-up length. The presence of residual confounding was acknowledged as a primary limitation, and its potential impact was interpreted in accordance with external confounding adjustment methodology described by Greenland and O'Rourke.[48]

For continuous outcomes evaluated via WMD, data normality was screened by calculating the mean-to-standard-deviation (SD) ratio for each included study. Ratios below 2 indicated normal or minimally skewed distributions, whereas ratios ≥ 2 signaled substantial skewness that could influence pooled estimates.

Subgroup analyses were conducted in RevMan to explore potential sources of clinical and surgical heterogeneity. Meta-regression models in STATA were adjusted for publication year, median follow-up duration, sample size, and study design to determine their relative

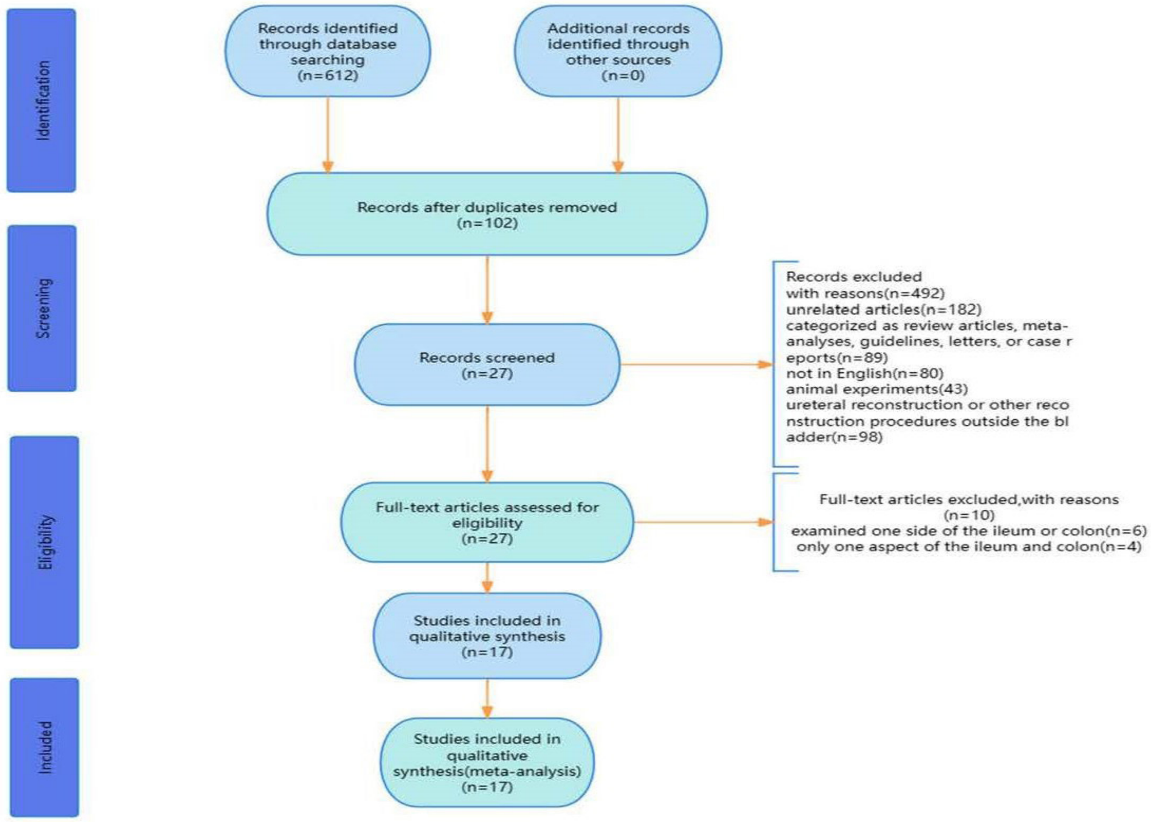

Figure 1. PRISMA 2020 flow diagram showing literature identification, screening, eligibility assessment, and final study inclusion for this systematic review and meta-analysis.

contribution to inter-study variability.

Publication bias was evaluated using Begg's rank correlation test and Egger's linear regression test in STATA, with visual inspection of funnel plots generated in RevMan for outcomes with ≥ 10 contributing studies. A two-tailed $P < .05$ was considered indicative of significant publication bias. Pooled results were interpreted primarily on the basis of effect sizes and 95% CIs rather than statistical P values alone. Sensitivity analyses were performed by sequentially omitting studies with lower NOS scores to test the stability of pooled estimates.

Grading of Evidence Certainty

We implemented the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework to quantify the certainty of evidence for each outcome. Randomized trials began at high certainty, whereas observational cohort studies started at low certainty. Evidence quality was downgraded across five domains: risk of bias, inconsistency, indirectness, imprecision, and publication bias. Detailed GRADE profiles are presented in **Table 2**.

RESULTS

Literature Search and Study Characteristics

An updated search through June 29, 2026, yielded no additional comparative studies meeting all eligibility criteria. The PRISMA 2020 flow diagram (**Figure 1**) illustrates the complete selection process. A total of 621 records were initially retrieved from PubMed, Embase, and Web of Science. Following removal of 102 duplicate publications, 492 articles were excluded during title and abstract screening. Excluded items comprised 182 non-relevant articles, 89 non-original publications (reviews, meta-analyses, editorials, letters, and case reports), 80 non-English papers, 43 animal experiments, and 98 studies describing ureteral or non-bladder reconstructive procedures.

Of the 27 full-text articles retrieved for detailed scrutiny, six were excluded because they lacked a comparative colonic cohort, and four lacked extractable data on functional outcomes (with a minimum requirement of three datasets per pooled outcome). Consequently, 17 studies met all inclusion criteria: one randomized controlled trial (RCT) and 16 prospective or retrospective cohort studies published between 1999 and 2019. Detailed baseline characteristics are presented in Figure 1 and Table 1. All 16 cohort studies attained NOS scores ≥ 7, indicating moderate-to-high methodological quality.

Risk of Bias Across Included Studies

All 16 observational cohort studies achieved NOS scores between 7 and 8 points (**Table 1**). The single included RCT demonstrated low overall risk of bias across most RoB 2 domains, with an unclear risk noted only in allocation concealment. General methodological limitations across the cohort studies included variable duration of follow-up and absence of standardized multivariable adjustment for surgical confounders.

Functional Outcomes Related to Storage Function:

Daytime and Nighttime Continence

Daytime continence data were extracted from 14 comparative studies.[5,9,13,14,16,22,23,25,26,31-33,37,39] These investi-

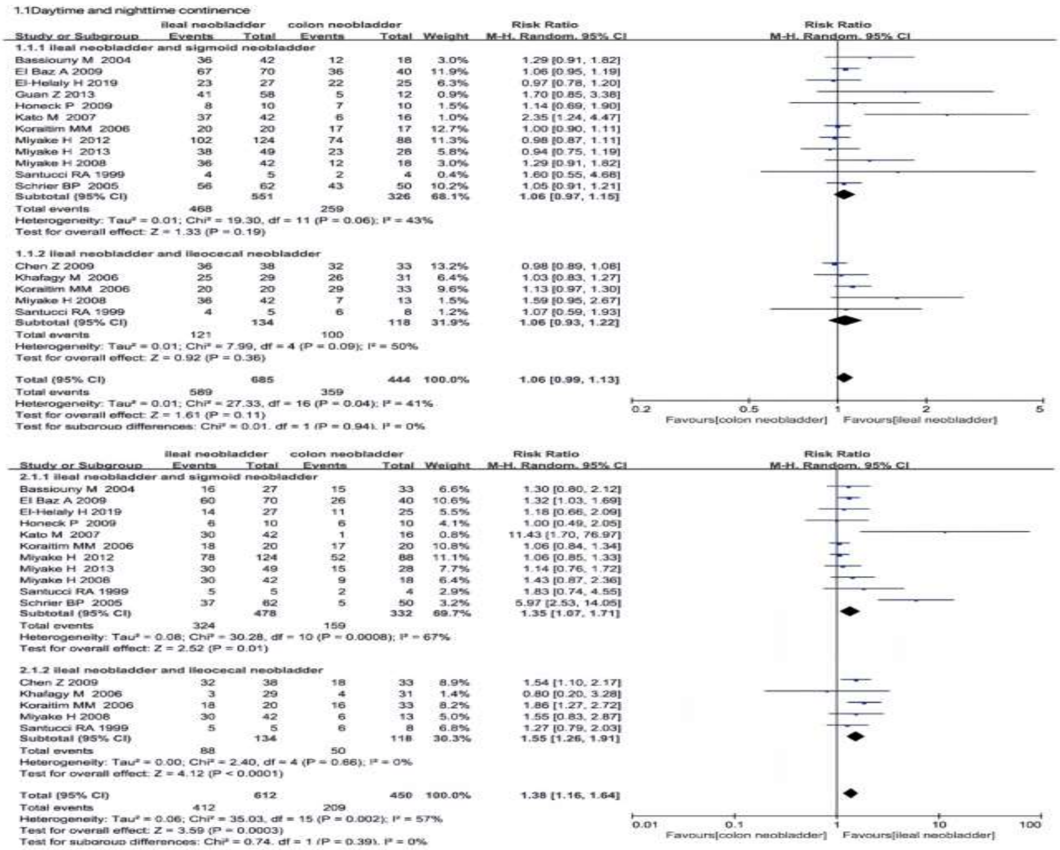

Figure 2. Forest plots of pooled risk ratios comparing daytime continence and nighttime continence between ileal and colon orthotopic neobladder subgroups.

gations were stratified into two comparison subgroups: INB versus SNB and INB versus ICNB. The pooled RR for daytime continence between INB and the combined CNB cohort was 1.06 (95% CI: 0.99–1.13), with moderate heterogeneity (I^2 = 41%, *P* for heterogeneity = .04). Because the 95% CI crossed the null value of 1, no statistically significant difference in daytime continence was observed between groups. Potential publication bias was suggested by Begg's test (*P* = .019) and Egger's test (*P* = .003).

In subgroup analysis comparing INB with SNB, the pooled RR was 1.06 (95% CI: 0.97–1.15, I^2 = 43%, *P* for heterogeneity = .06), demonstrating equivalent daytime continence. Similarly, for the INB versus ICNB subgroup, the pooled RR was 1.06 (95% CI: 0.93–1.22, I^2 = 50%, P for heterogeneity = .09), showing no significant intergroup difference.

Regarding nighttime continence, the pooled RR comparing INB with all CNB configurations was 1.43 (95% CI: 1.28–1.60, I^2 = 57%, *P* for heterogeneity = .002). The 95% CI fell entirely above 1, demonstrating statistically superior nighttime continence in the INB cohort. Egger's test indicated potential publication bias (*P* = .033), whereas Begg's test showed no significant asymmetry (*P* = .137). Although this difference achieved statistical significance, the clinical magnitude was modest.

Subgroup analyses demonstrated consistent findings:

INB versus SNB: pooled RR = 1.41 (95% CI: 1.24–1.60, I^2 = 67%, *P* for heterogeneity = .0008), confirming statistically superior nocturnal control in the INB group.

INB versus ICNB: pooled RR = 1.53 (95% CI: 1.23–1.92, I^2 = 0%, P for heterogeneity = .66), showing superior nighttime continence with INB.

Forest plots for daytime and nighttime continence are presented in **Figure 2**. GRADE assessment indicated low certainty of evidence for both outcomes (**Table 2**). Funnel plots (**Figure 6a and Figure 6b**) displayed visual asymmetry for daytime continence, with small-sample studies clustering to the right of the null line, corroborated by Begg's (*P* = .019) and Egger's tests (*P* = .003). The funnel plot for nighttime continence displayed mild asymmetry, where Egger's test indicated small-study effects (*P* = .033) despite non-significance in Begg's test (*P* = .137).

Pooled results for maximum bladder capacity are illustrated in Figure 3. The GRADE certainty for this outcome was judged as low (**Table 2**).

Functional Outcomes Related to Voiding Function: Postvoid Residual Volume and Clean Intermittent

Catheterization

Data regarding postvoid residual volume were synthesized from 10 studies.(1,5,9,13,22,23,32,33,37,39) The pooled WMD was 12.89 mL (95% CI: -0.85 to 26.63 mL), with substantial heterogeneity (I^2 = 84%, *P* for heterogeneity < .00001). Begg's test (*P* = .640) and Egger's test (*P* = .265) suggested no substantial publication bias.

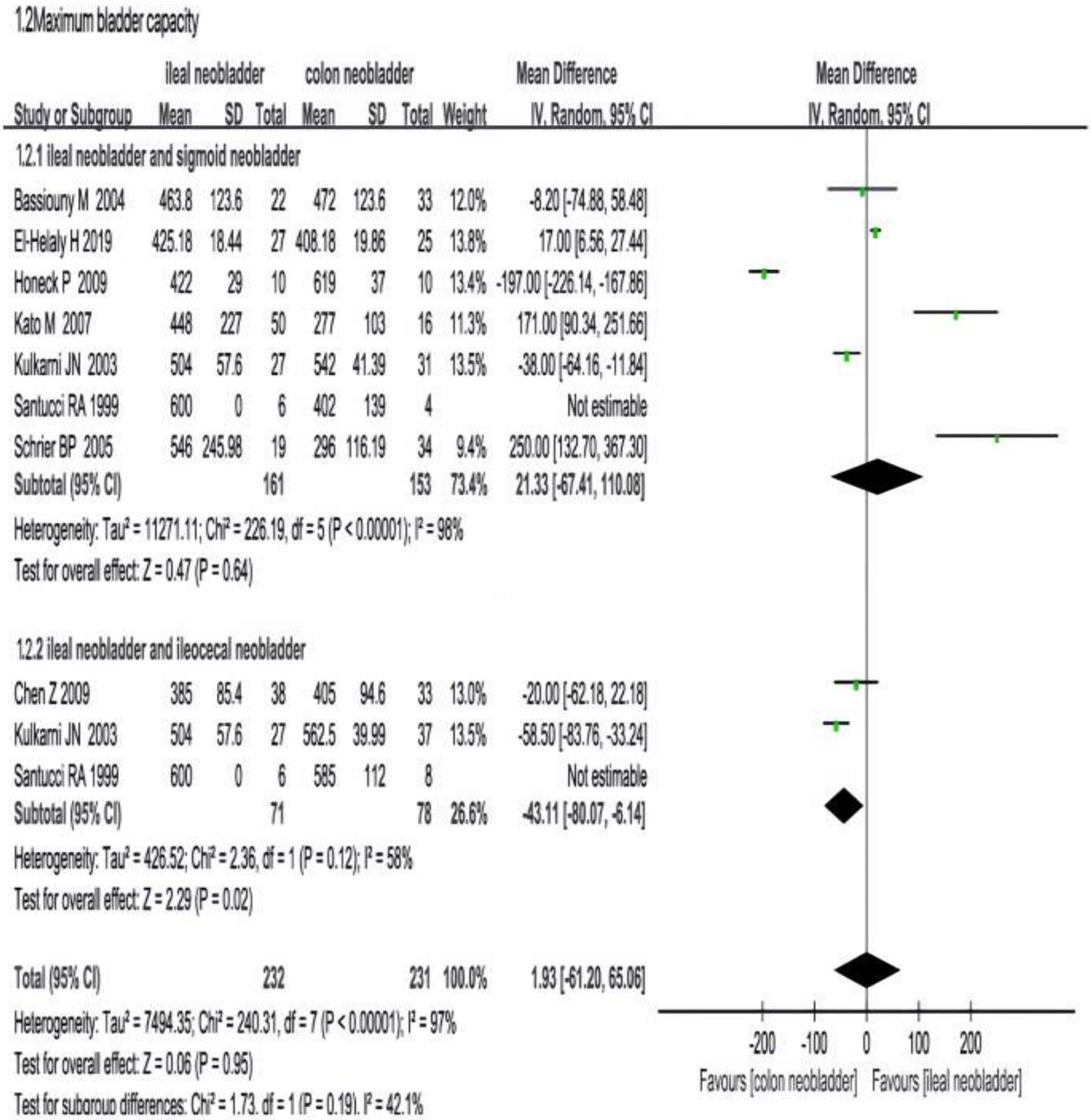

Figure 3. Forest plot of pooled weighted mean difference in maximum bladder capacity between ileal and colon neobladder groups.

Subgroup analysis of INB versus SNB showed a pooled WMD of 20.71 mL (95% CI: 0.73 to 40.68 mL, I^2 = 83%, *P* for heterogeneity < .00001), indicating a statistically higher postvoid residual volume in the INB cohort. In the INB versus ICNB subgroup, the pooled WMD was -0.40 mL (95% CI: -15.93 to 15.14 mL, I^2 = 70%, P for heterogeneity = .02), showing no significant difference. Mean-to-SD ratios across individual studies were < 2, confirming acceptable data distribution for parametric pooling.

Forest plots for postvoid residual volume are displayed in Figure 4. The GRADE certainty of evidence was moderate (**Table 2**). The corresponding funnel plot (**Figure 6c**) demonstrated visual symmetry, consistent with Begg's (*P* = .640) and Egger's tests (*P* = .265).

Clean intermittent catheterization (CIC) usage was reported in six studies.(13,28,31-34) The overall pooled RR was 1.59 (95% CI: 1.01–2.53, I^2 = 0%, *P* for heterogeneity = .85), showing statistically more frequent CIC dependency in INB patients than in CNB patients. In subgroup analysis of INB versus SNB, the pooled RR was 1.74 (95% CI: 1.05–2.88, I^2 = 0%, P for heterogeneity = .89), confirming greater CIC utilization among INB recipients. Conversely, no significant difference was identified between INB and ICNB (pooled RR = 0.89, 95% CI: 0.27–2.93). Pooled CIC findings are

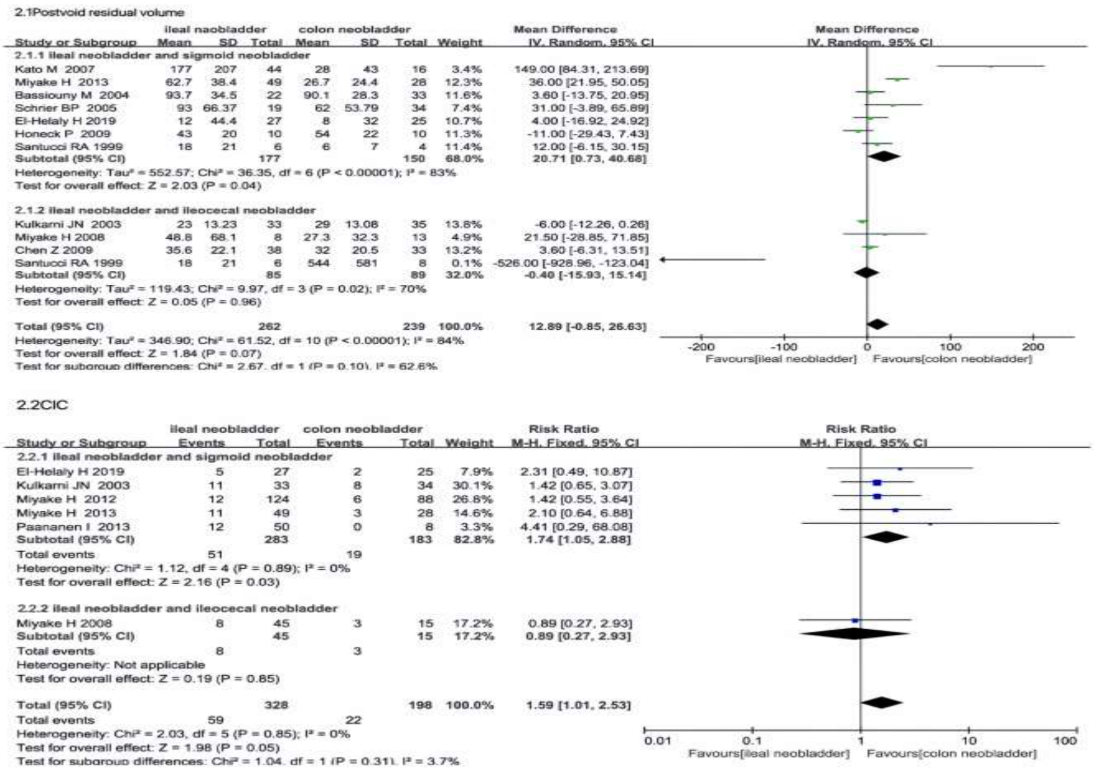

Figure 4. Forest plots of pooled weighted mean difference for postvoid residual volume and pooled risk ratio for clean intermittent catheterization rates across neobladder subtypes

summarized in Figure 4, with evidence certainty graded as low (**Table 2**).

Safety Indicators: Early and Late Postoperative Complications

Early and late postoperative complications were analyzed across six comparative studies.(5,13,16,25,28,32) For early postoperative complications, the pooled RR was 0.75 (95% CI: 0.60–0.92, I^2 = 0%, *P* for heterogeneity = .46), demonstrating a significantly lower incidence of early complications in the INB group compared with the overall CNB cohort. In subgroup analysis of INB versus SNB, the pooled RR was 0.78 (95% CI: 0.63–0.98, I^2 = 0%, *P* for heterogeneity = .54), confirming a lower early complication rate with INB. In contrast, the comparison between INB and ICNB showed no statistically significant difference (pooled RR = 0.45, 95% CI: 0.20–1.04).

For late postoperative complications, the pooled RR comparing INB with overall CNB was 1.06 (95% CI: 0.75–1.51, I^2 = 0%, *P* for heterogeneity = .88), indicating comparable long-term complication risks. Subgroup analyses yielded consistent results: INB versus SNB had a pooled RR of 1.09 (95% CI: 0.73–1.64, I^2 = 0%, P for heterogeneity = .78), and INB versus ICNB had a pooled RR of 0.97 (95% CI: 0.50–1.89). Forest plots for early and late complications are presented in Figure 5, and the GRADE certainty for both endpoints was rated low (**Table 2**).

DISCUSSION

Orthotopic neobladder reconstruction represents an established form of continent urinary diversion following radical cystectomy, and the selection of an optimal bowel segment remains an important clinical consideration. Regarding urinary storage function, INB demonstrated superior nocturnal continence compared with both SNB and ICNB, while daytime continence rates were equivalent. Regarding voiding function, INB exhibited higher postvoid residual urine volumes and increased reliance on clean intermittent catheterization compared with SNB, with no significant differences observed between INB and ICNB. Regarding surgical safety, INB was associated with significantly fewer early postoperative complications than SNB, whereas early complication rates were comparable between INB and ICNB. Long-term complication rates did not differ significantly between INB and any colonic configuration.

All pooled effect sizes in this meta-analysis represent unadjusted crude estimates because original studies did not report standardized multivariate models. Key clinical confounders—such as patient age, tumor stage, baseline renal function, and hospital surgical volume—could not be uniformly controlled across studies. The potential influence of residual confounding must therefore be considered when interpreting these findings, consistent with external confounding estimation principles described by Greenland and O'Rourke.(48)

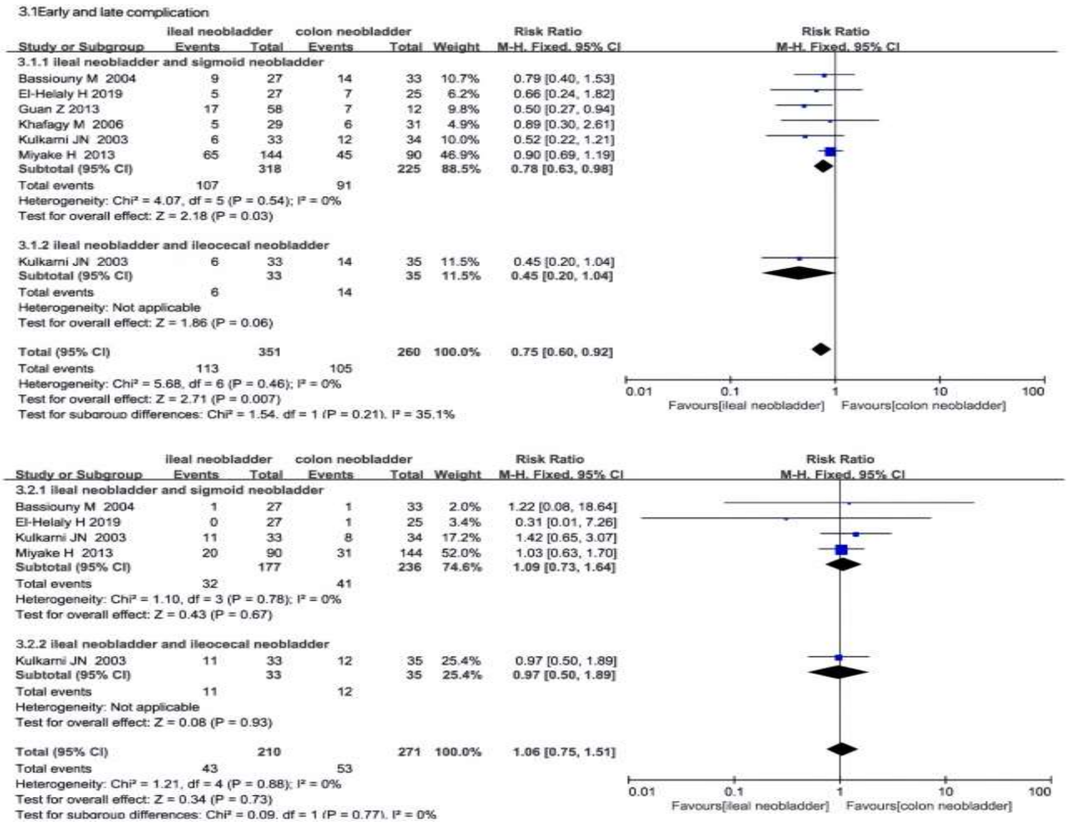

Figure 5. Forest plots of pooled risk ratios for early and late postoperative complications comparing ileal and colon orthotopic neobladder reconstruction

Urine Storage Function in Orthotopic Neobladder

Our pooled analysis demonstrated equivalent daytime continence between INB and CNB, whereas INBs achieved significantly superior nighttime continence. These results align with an RCT of 71 patients undergoing RC with either ileal or ileocolonic reconstruction, which reported identical daytime continence rates between INB and ICNB (P = .580) but significantly higher nighttime continence in the INB arm (P = .015).[9]

Conversely, an earlier systematic review concluded that INB achieved superior daytime continence compared with SNB (RR = 0.87, 95% CI: 0.81–0.94, I^2 = 0.0%).[45] This discordance likely reflects the fact that the earlier review evaluated only retrospective cohorts. By incorporating prospective cohorts and an RCT alongside recent evidence, our analysis provides an updated synthesis. Orthotopic neobladders lack native afferent detrusor reflexes, predisposing patients to nocturnal incontinence during sleep when voluntary pelvic floor tone declines.[7,26] The higher rate of nighttime leakage in SNBs may stem from poorer reservoir compliance and irregular, uncoordinated contractions of the sigmoid colon. Improving pouch detubularization and spherical geometry may improve compliance and nocturnal control in colonic reservoirs.[23,28,39] Notably, a retrospective study of 88 male patients reported no difference in nighttime continence between INB and CNB (P > .05).[26] However, female patients have distinct pelvic floor anatomy, shorter urethral length, and inherently higher rates of stress incontinence, making conclusions derived exclusively from male cohorts limited in generalizability.

Voiding Function in Orthotopic Neobladder

CIC utilization provides an indirect measure of incomplete bladder emptying and spontaneous micturition efficacy.[13] Our analysis revealed that INB recipients had a significantly higher rate of CIC dependence than SNB recipients, with no difference noted between INB and ICNB. Because CIC frequency parallels postvoid residual urine volumes, these findings indicate that SNBs offer superior spontaneous emptying dynamics. In agreement, a prospective multicenter trial comparing four neobladder configurations recorded numerically lower CIC requirements in sigmoid pouches than in ileal substitutes (P = .334).[34] The voiding advantages of colonic reservoirs may relate to autonomic neural anatomy: sacral parasympathetic innervation from S2–S4 directly supplies the distal colon, providing robust neural drive and peristaltic clearance during abdominal straining.[26] Although single-center studies showed small differences in CIC rates, our quantitative pooling revealed a statistically significant trend across cohorts, illustrating the utility of meta-analysis in resolving equivocal findings from small series.

Safety and Postoperative Complications

Early complications—including surgical site infections, paralytic ileus, mechanical small bowel obstruction,

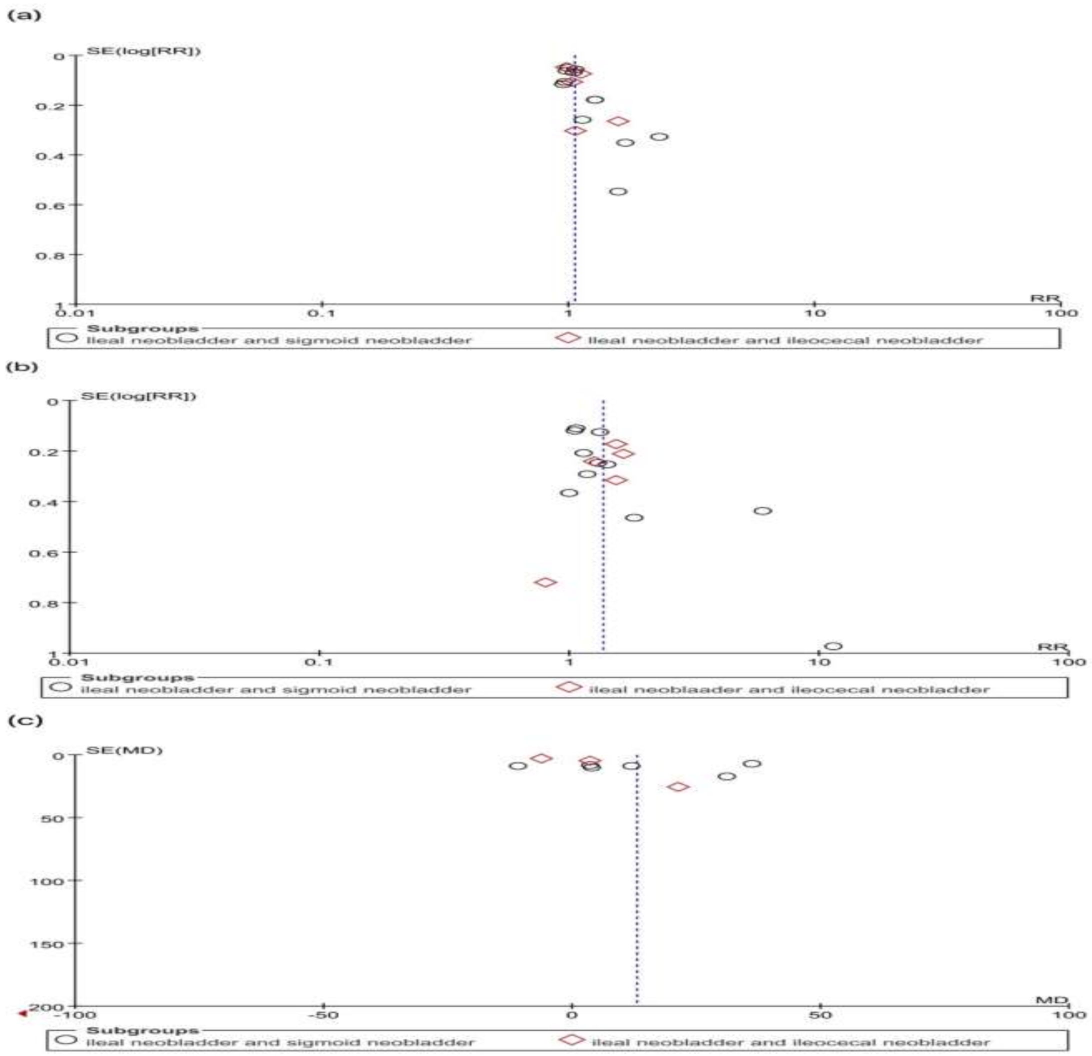

Figure 6. Funnel plots for publication bias assessment. **(a)** Daytime continence; **(b)** Nighttime continence; **(c)** Postvoid residual volume.

urinary leakage, and pyelonephritis—were significantly less frequent with INB than with SNB.[16,18-20,28,30,42,46] In a retrospective series of 70 patients, early complications occurred in 58.3% of CNB patients compared with 29.3% of INB recipients, with bowel obstruction predominating in both groups.[9] The lower complication rate in INB may be explained by the relative ease of bowel mobilization, reliable mesenteric blood supply, and smaller diameter of the ileum, which facilitates tension-free enterostomy and reduces prolonged ileus.[16] Conversely, technical modifications such as submucosal tunneling during ureterosigmoid anastomosis may reduce anastomotic stricture and urinary leakage in colonic pouches. Contemporary advances in perioperative care and surgical technique have progressively mitigated early morbidity across all reconstructive approaches.[17,43]

Late complications—such as ureterointestinal stricture, neobladder lithiasis, metabolic acidosis, and reflux nephropathy—demonstrated equivalent incidences between ileal and colonic substitutes.[5,32,44,47] A recent comparative study of 52 patients noted late complication rates of 24.0% for INB and 22.2% for SNB, corroborating our findings.[13] Urethroenteric anastomotic stricture remains the most common late complication regardless of intestinal segment, mediated by chronic mucosal inflammation, ischemia, and peri-anastomotic fibrosis.[47] Long-term surveillance is therefore required for all neobladder recipients.

Limitations and Innovations

Several limitations should be considered. First, the sample size in the ICNB subgroup was relatively small, limiting the statistical power of comparative assessments for this subtype. Second, primary studies lacked standardized definitions for continence, voiding dysfunction, and health-related quality of life. Third, 16 of the 17 included studies were observational cohorts with inherent potential for selection bias. Certain continuous variables required mathematical conversion from medians and interquartile ranges, which may introduce minor numerical imprecision. In addition, funnel plot asymmetry indicated potential publication bias for daytime and nighttime continence outcomes, which could overestimate the benefits of ileal segments. Methodologically robust, multicenter randomized trials are required to

confirm these observations.
Regarding innovations, this study updates prior meta-analytic literature by integrating recently published prospective and randomized comparative data. Furthermore, it provides dedicated subgroup comparisons for both sigmoid and ileocecal neobladders, offering clinical insight into the specific characteristics of individual bowel segments.

CONCLUSIONS

Ileal neobladder provides superior nighttime urinary continence and lower early postoperative complication rates compared with sigmoid neobladder, whereas sigmoid neobladder demonstrates lower postvoid residual volumes and reduced clean intermittent catheterization dependence. Evidence certainty is rated low to moderate per GRADE assessment, primarily limited by the observational nature of primary data and inter-study heterogeneity. No single neobladder type is universally superior, and reconstructive choice should be individualized according to patient functional priorities, comorbidities, and surgical expertise.

SUMMARY

After bladder removal, ileal neobladders provide better nighttime urine control and fewer early complications than colon neobladders, while sigmoid neobladders allow easier natural bladder emptying. Pouch choice should be tailored to each patient.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

APPENDIX

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