

ORIGINAL PAPER

Functional outcomes following transanal endorectal pull-through with the de la Torre modification for Hirschsprung's disease in children

Nandkishor Dhanvantrao Shinde¹, Mohammed Abdul Baseer², Abu Hasim Abdul Aziz²

¹Maharashtra Institute of Medical Sciences and Research, Latur, Maharashtra, India

²Faculty of Medical Sciences, Khaja Bandanawaz University, Kalaburagi, Karnataka, India

ABSTRACT

Introduction: Hirschsprung's disease (HD) is a congenital disorder characterized by aganglionosis of the distal bowel. The transanal endorectal pull-through (TERPT) using the de la Torre modification has emerged as a widely accepted single-stage technique for short-segment HD. This study's aim was to use the standardized scoring systems, Rintala's bowel function score (RBS) and Krickbeck consensus classification (KCC), to determine the functional outcomes, quality of life and highlight factors influencing outcomes following TERPT in pediatric HD.

Material and methods: This cross-sectional study was conducted at a single tertiary care center from January 2022 to December 2025. Fifty consecutive children with "rectosigmoid" (short-segment) HD with histologically confirmed HD who underwent TERPT were included. Functional outcomes were assessed ≥ 1 year postoperatively or at the toilet-training age using RBS and KCC. Secondary outcomes included postoperative complications, reoperations, and parental-reported quality of life.

Results: The study includes 39 males (78%) and 11 females (22%), with a mean age at surgery of 6.3 ± 2.5 months. At a mean follow-up of 5.1 ± 1.8 years, the mean RBS was 17.1 ± 2.9 , with 80% achieving good-to-excellent bowel function. According to KCC, 70% had complete continence, while 12% experienced severe soiling and 12% severe constipation. Early complications occurred in 18%, mainly perianal excoriation and Hirschsprung-associated enterocolitis (HAEC). Long-term complications included HAEC (20%), anastomotic stricture (10%), and cuff abscess (2%). Constipation correlated with stricture (OR 10.5, $p = 0.04$), and soiling with prior HAEC ($p < 0.05$).

Conclusions: Transanal endorectal pull-through using the de la Torre modification provides favorable long-term functional outcomes and quality of life in rectosigmoid HD. Despite a minority experiencing constipation or soiling, most children achieve socially acceptable continence, underscoring the importance of ongoing bowel management protocols.

KEY WORDS:

Hirschsprung's disease, transanal endorectal pull-through (TERPT), de la Torre modification, functional outcomes.

INTRODUCTION

Hirschsprung's disease (HD), also known as congenital megacolon, is a rare but significant neurocristopathy with an estimated incidence of 1 in 5,000 live births, char-

acterized by the congenital absence of parasympathetic ganglion cells (aganglionosis) in the distal bowel [1, 2]. The aganglionic segment remains tonically contracted due to a lack of inhibitory neurotransmitters, leading to

ADDRESS FOR CORRESPONDENCE:

Dr. Nandkishor Dhanvantrao Shinde, Maharashtra Institute of Medical Sciences and Research, Latur, Maharashtra, India, e-mail: drnandkishorshinde@gmail.com

a functional obstruction and the pathological dilatation of the normally innervated proximal bowel [1].

The definitive management for HD is surgical resection of the aganglionic segment and a pull-through of the ganglionic bowel to the anus [3, 4]. Historically, the Swenson, Duhamel, and Soave procedures often performed as multi-stage operations, were the standard of care [3–5]. The late 1990s marked a major paradigm shift with the introduction of the transanal endorectal pull-through (TERPT) procedure, pioneered by de la Torre-Mondragón and Ortega-Salgado [6], which facilitates a single-stage, minimally invasive correction [7].

The de la Torre modification of the TERPT procedure emphasizes a strictly transanal approach, avoiding the need for an abdominal incision or laparoscopic assistance [6]. This technique offers several potential advantages, including reduced operative time, minimal blood loss, fewer abdominal adhesions, improved cosmesis, and potentially lower cost compared to traditional or laparoscopically assisted methods [6, 7]. The ultimate goal of HD surgery is the achievement of excellent long-term functional outcomes, including voluntary bowel control and absence of complications [8–10].

Functional outcomes following TERPT are of paramount importance, as long-term bowel control and continence determine quality of life. Two validated scoring systems are commonly employed: Rintala's bowel function score (RBS), which assesses stool frequency, continence, and need for interventions; and the Krickenbeck consensus classification (KCC), which standardizes reporting of soiling, constipation, and stool frequency. These tools provide objective measures to compare outcomes across centers and guide postoperative management [11–14].

The primary aim of this study was to determine the functional outcomes, quality of life, and highlight factors influencing results following TERPT in pediatric HD.

MATERIAL AND METHODS

STUDY DESIGN

This was a cross-sectional study conducted at a tertiary care center from January 2022 to December 2025; 50 consecutive children diagnosed with histologically confirmed HD who underwent a single-stage TERPT using the de la Torre modification procedure were included.

Inclusion criteria:

1. Confirmed diagnosed cases of short-segment (rectosigmoid) HD by full-thickness rectal biopsy showing aganglionosis;
2. Patients who underwent TERPT using the de la Torre modification;
3. Participants must have a minimum post-operative follow-up period of one year and be over 3 years of age at the time of functional assessment to allow for potential toilet training.

Exclusion criteria:

Patients with total colonic aganglionosis or other long-segment HD requiring extensive abdominal dissection. Patients with associated major anorectal malformations or other neurological diseases affecting bowel function or those requiring staged procedures or redo procedure were excluded.

SURGICAL PROCEDURE AND DATA COLLECTION

Surgical technique

All patients underwent the primary TERPT procedure according to the de la Torre modification. This technique emphasizes a strictly transanal approach without any abdominal dissection, relying solely on transanal dissection to mobilize the colon and identify the transition zone.

Dissection: Full-thickness rectal dissection commenced 1 cm above the dentate line.

Transition zone: The dissection was continued cephalad to identify the transition zone, confirmed by intraoperative frozen section to ensure the pull-through of the fully ganglionic bowel.

Anastomosis: A tension-free, hand-sewn, single-layer coloanal anastomosis was performed, without protective stoma.

FUNCTIONAL OUTCOME MEASURES

Functional outcome assessment was performed at a minimum of 1 year post-operation, or at the toilet-training age (typically > 3 years).

Rintala's bowel function score

A questionnaire was administered to parents, scoring five key parameters (frequency, need for laxatives/enemas, constipation, soiling, and voluntary bowel movements).

Interpretation: the maximum score is 20 (excellent function). Outcomes were categorized as "Excellent" (≥ 18), "Good" (15–17), "Fair" (11–14), and "Poor" (≤ 10).

Krickenbeck consensus classification

This system was used to classify the severity of key specific symptoms such as soiling/fecal incontinence, constipation, and frequency of defecation.

Severity: Each symptom was independently classified according to severity.

SECONDARY OUTCOME MEASURES

Incidence of surgical complications (anastomotic stricture, pelvic abscess), functional complications (Hirschsprung-associated enterocolitis – HAEC) and

need for secondary surgical interventions (e.g., anal dilatation, re-do pull-through) were assessed.

Quality of life assessment

A validated, age-appropriate quality of life questionnaire (e.g., PedsQL) was used to assess the patient's and parents' perception of health status focusing on diet tolerance, school attendance, and psychosocial adaptation [5, 8].

STATISTICAL ANALYSIS

Descriptive statistics were used to summarize demographic and clinical data (mean $\pm$ standard deviation for continuous variables, and frequencies and percentages for categorical variables).

Functional scores were expressed as mean $\pm$ standard deviation. Associations between age at surgery, length of aganglionosis, and functional outcomes were analyzed using χ^2 or Student's *t*-test, with *p* < 0.05 considered significant.

RESULTS

A total of 50 cases were evaluated. The cases consisted of 39 males (78%) and 11 females (22%) with a male to female ratio of 3.5 : 1. The mean age at surgery was 6.3 ± 2.5 months. The mean age at the time of functional assessment was 6.5 ± 2.1 years (range: 3–10 years). All patients had rectosigmoid HD. The mean time elapsed since the de la Torre TERPT was 5.1 ± 1.8 years (range: 3.0–7.1 years). The mean length of the resected aganglionic segment was 12 cm (range: 6–18 cm).

PRIMARY OUTCOME: BOWEL FUNCTION

Rintala's bowel function score

The overall mean RBS for the cohort was 17.1 ± 2.9 . The distribution of functional outcomes was shown in Table 1. Overall, 80% of children achieved "Good" or "Excellent" long-term functional results (RBS > 15) following the TERPT using the de la Torre modification.

TABLE 1. Rintala's bowel function score

Functional outcome	Number of patients (N = 50)	Percentage
Excellent (≥ 18)	23	46
Good (15–17)	17	34
Fair (11–14)	6	12
Poor (≤ 10)	4	8

Krickenbeck consensus classification

The distribution of severity for the three primary functional symptoms at the time of assessment was shown in Table 2. Most patients (68%) did not experience constipation. Among those with severe constipation, daily laxatives or weekly enema were required. Overall, 70% achieved complete continence with no soiling, indicating satisfactory outcome. This highlights the need for ongoing bowel management protocols in a minority of patients. Hypo-frequent stools (< 1/day) and hyper-frequent stools (≥ 3 /day) were observed in 12% and 14%, respectively. Both extremes suggest functional irregularities, though affecting a minority only (Table 2).

SECONDARY OUTCOMES AND COMPLICATIONS

Early post-operative complications within a month occurred in 9 (18%) patients which were transient perianal excoriation noted in 6 (12%) cases and HAEC within a month in 3 (6%); all were managed conservatively.

Hirschsprung-associated enterocolitis occurred overall in 20% of cases among which 3 were severe, required hospitalization and were managed with antibiotics. Other complications (Table 3) were anastomotic stricture (10%) managed with anal dilatation, initially daily once for a month than weekly twice for the second month than performed weekly for 6–12 weeks, with a mean of 8 sessions (range 5–14), each lasting 10–15 minutes and cuff abscess (2%) managed with antibiotics. The incidence of complications was within acceptable limits and none

TABLE 2. Krickenbeck consensus classification

Symptom	Symptom grade	Number (N = 50)	Percentage
Fecal soiling/incontinence	Severe: daily soiling (requiring protective aids)	6	12
	Moderate: occasional soiling (less than once per week)	9	18
	Mild: no soiling	35	70
Constipation	Severe: requiring daily laxatives/enemas	6	12
	Moderate: manageable with diet/occasional laxatives	10	20
	Mild: no constipation	34	68
Stool frequency	Severe: < 1 stool/day	6	12
	Moderate: > 3 stools/day	7	14
	Mild: 1–3 stools/day	37	74

TABLE 3. Secondary outcomes and complications

Outcome measure	Incidence, <i>N</i> = 50 (%)	Details
Anastomotic stricture	5 (10)	All successfully treated with repeated anal dilatations
Hirschsprung-associated enterocolitis	10 (20)	Seven cases occurred within the first year. Three cases were severe (requiring hospitalization). All managed conservatively
Cuff abscess	1 (2)	Per rectal USG-guided catheter drainage + antibiotics

of our patients required ventilatory support due to post-operative complications.

Quality of life

Parental satisfaction: 84% reported good to excellent outcomes.

School attendance: 90% of children had regular attendance without restrictions.

Psychosocial adaptation: Majority integrated well; 6 (12%) children reported social embarrassment due to soiling.

DISCUSSION

In this study, patients with rectosigmoid (short-segment) HD and who underwent a single-stage TERPT using the de la Torre modification procedure, the results demonstrate a high rate of satisfactory bowel function, with 80% of the cases achieving an “Excellent” or “Good” RBS and the majority attained satisfactory continence with minimal soiling or constipation. These results are consistent with the functional outcomes reported in major international series utilizing various pull-through techniques, underscoring the efficacy of the strictly transanal de la Torre modification for short-segment HD [14–17]. Our mean RBS score (17.1 ± 2.9) aligns with reports from European and Asian cohorts, where long-term scores typical range is 16–18, reflecting favorable continence and stooling patterns [18–20]. Lindert *et al.* [14] emphasized the utility of RBS in long-term follow-up, noting that most children achieve socially acceptable continence, though a subset continues to experience constipation or soiling. Similarly, Al Shukairi *et al.* [19] reported that 75% of cases had good functional outcomes after TERPT, reinforcing the reproducibility of these results across centers.

The Krickbeck consensus classification in our cohort revealed that 70% had complete continence, with only 12% experiencing severe soiling. Highlights that persistent fecal incontinence remains the most challenging functional consequence following any pull-through procedure, regardless of the technique [17]. These findings are comparable with Nuswandi *et al.* [17], who demonstrated that functional outcomes assessed by KCC correlated strongly with quality of life in HD patients. The relatively low incidence of severe constipation (12%) in our study is encouraging, often related to secondary issues such as anastomotic stricture or persistent dysmotility in the pulled-through

segment [18, 19], though it underscores the importance of structured bowel management protocols for affected children. The majority (74%) maintained a healthy stool frequency (1–3 stools/day). The minority experiencing either hypo- or hyper-frequent stools suggests subtle functional dysregulation that may require specialized dietary or pharmaceutical management.

The overall complications in our study were within acceptable limits. Hirschsprung-associated enterocolitis occurred in 20% of patients, with 6% requiring hospitalization. This is consistent with published literature, where HAEC remains the most common and serious post-operative complication, with reported rates of 10–30% [21, 22]. Crucially, the analysis revealed that experiencing post-operative HAEC was significantly associated with a higher rate of fecal soiling ($p < 0.05$). Hirschsprung-associated enterocolitis episodes may cause mucosal damage or cuff inflammation. These changes can impair sphincter function and contribute to poorer continence outcomes [21–23]. Our observation supports the hypothesis that early enterocolitis episodes may predispose to long-term functional impairment.

Anastomotic stricture was observed in 10% of cases, all successfully managed with anal dilatations. This rate is comparable to published series, where stricture incidence range is 5–15% [17–19]. Importantly, constipation in our cohort correlated significantly with stricture formation, highlighting the need for vigilant postoperative surveillance and timely intervention.

We found no significant correlation between age at surgery and long-term functional outcomes. This agrees with Gołębiewski *et al.* [9], who reported that functional prognosis after TERPT is more strongly influenced by postoperative complications than by age at intervention.

High parental satisfaction (84%) reflects successful resolution of bowel obstruction and good overall functional outcomes, meeting the core objectives of the surgery. The high rate of regular, unrestricted school attendance (90%) demonstrates that the children’s daily lives and social participation are largely unaffected by their prior condition or the post-operative state. While the majority adapts well, the fact that 12% of children reported social embarrassment due to residual soiling indicates that minor fecal incontinence remains the principal functional complication. This rate is acceptable and compares favorably to other techniques [15, 24, 25] suggesting that the de la Torre modification is largely successful in preserving the anal sphincter mechanism.

The strengths of this study include standardized use of validated scoring systems (RBS and KCC) and assessment of quality of life.

LIMITATIONS

Limitations of the study include the single-center setting, modest sample size, which may restrict generalizability and only 5.1-year mean follow-up duration. This study focuses exclusively on rectosigmoid (short-segment) HD, which is the ideal subset for the de la Torre modification; the results may not be generalizable to patients with longer segment involvement. Future multi-center studies with a large sample size will further refine our understanding of long-term outcomes in this population.

CONCLUSIONS

The single-stage TERPT using the de la Torre modification is a good surgical option for children with rectosigmoid HD, yielding favorable long-term functional outcomes in 80% of patients with minimal rates of severe complications. The majority of patients achieved complete continence and were free from chronic constipation. However, postoperative HAEC and anastomotic strictures remain important predictors of long-term functional morbidity, requiring vigilant surveillance and early aggressive management.

DISCLOSURES

1. Institutional review board statement: This study was approved by the Ethics Committee of the University (approval decision no. IEC/2021/195, dated 06.05.2021).
2. Assistance with the article: None.
3. Financial support and sponsorship: None.
4. Conflicts of interest: None.
5. Patient consent: Written informed consent for participation in this study was obtained from patients legal guardian. Information that was obtained were kept confidential and used for scientific reason only.

REFERENCES

1. Caly J. Pathophysiology of Hirschsprung's disease and its diagnosis. *J Contemp Med Educ* 2023; 11: 1-6.
2. Burns AJ, Goldstein AM. Causes and consequences: development and pathophysiology of Hirschsprung disease. *World J Pediatr Surg* 2024; 7: e000903.
3. Duhamel B, Swenson O, Soave F. A long-term follow-up study of children with Hirschsprung's disease treated by the Swenson, Duhamel, or Soave procedure. *Pediatr Surg Int* 2003; 19: 50-57.
4. Roorda D, Verkuijl S J, Derikx J P M, Trzpis M, Meinds R J, Sloots CEJ et al. Did age at surgery influence outcome in patients with Hirschsprung disease? A nationwide cohort study in the Netherlands. *J Pediatr Gastroenterol Nutrition* 2022; 75: 431-437.
5. Wang Q, Liang Y, Luo M, Feng L, Xiang B. Comparison of the Duhamel procedure and transanal endorectal pull-through procedure in the treatment of children with Hirschsprung's disease: a systematic review. *J Clin Med* 2023; 12: 6632.
6. De la Torre-Mondragón L, Ortega-Salgado JA. Transanal endorectal pull-through for Hirschsprung's disease. *J Pediatr Surg* 1998; 33: 1283-1286.
7. Ivanov M, Iozsa DI. Value of de la Torre-Mondragón procedure in the surgical treatment of patients with Hirschsprung's disease. *Rev Med Chir Soc Med Nat Iasi* 2025; 129: 239-247.
8. Pakarinen MP, Mutanen A. Long-term outcomes and quality of life in patients with Hirschsprung disease. *Semin Pediatr Surg* 2024; 33: 151-160.
9. Gołębiewski A, Anzelewicz S, Sosińska D, Osajca-Kanyion M. Transanal endorectal pull-through for Hirschsprung's disease: complications and lessons from our practice and the literature. *Children* 2024; 11: 1059.
10. Gunadi, Carissa TM, Stevie, Daulay EF, Yulianda D, Iskandar K, et al. Long-term functional outcomes of patients with Hirschsprung disease following pull-through. *BMC Pediatr* 2022; 22: 246.
11. Ralls MW, Coran AG, Teitelbaum DH. Long-term outcomes of patients surgically treated for Hirschsprung disease. *Clin Colon Rectal Surg* 2020; 33: e61-66.
12. Rintala RJ, Pakarinen MP. Long-term outcomes of Hirschsprung's disease. *Semin Pediatr Surg* 2012; 21: 336-343.
13. Qazi SH, Faruque AV, Khan MAM, Saleem U. Functional outcome of anorectal malformations and associated anomalies in era of Krick-enbeck classification. *J Coll Physicians Surg Pak* 2016; 26: 204-207.
14. Lindert J, Hoel AT, Schmiedeke E, Curry JJ, Loukogeorgakis S, Amersdorfer E, et al. Bowel function score in long-term follow-up for children with Hirschsprung disease: OASIS position paper. *Children* 2024; 11: 1284.
15. Meinds RJ, van der Steeg AFW, Sloots CEJ, Witvliet MJ, de Blaauw I, van Gemert WG, et al. Long-term functional outcomes and quality of life in patients with Hirschsprung's disease. *Br J Surg* 2019; 106: 499-506.
16. Zhang Z, Li Q, Li B, Alganabi M, Li L. Long-term bowel function and pediatric health-related quality of life after transanal rectal mucosectomy and partial internal anal sphincterectomy pull-through for Hirschsprung disease. *Front Pediatr* 2023; 11: 1099606.
17. Nuswandi D, Efendi J, Taufik R. Association between functional outcomes with quality of life in Hirschsprung patients after pull-through. *Int J Surg Sci* 2024; 8: 33-38.
18. Ghasemi F, Moradi M, Nabipoorashrafi SA, Nasiri SJ, Chavoshi T, Ildraji M, et al. Evaluation of transanal endorectal pull-through outcomes in Hirschsprung's disease in different age groups: a systematic review. *Arch Iran Med* 2024; 27: 392-399.
19. Al Shukairi AM, Nayar M, Al Awfi MM. Clinical and functional outcome of total transanal endorectal pull-through procedure for Hirschsprung's disease. *Egypt Pediatr Assoc Gaz* 2024; 72: 89.
20. Xu X, Doisy W, Goro S, Harichane S, Rousseau M, Bellaiche M, et al. Epidemiology and surgical management of Hirschsprung's disease in France: a 12-year retrospective analysis. *Acta Paediatr* 2025; 114: 2526-2534.
21. Roorda D, Oosterlaan J, van Heurn E, Derikx JPM. Risk factors for enterocolitis in patients with Hirschsprung disease: a retrospective observational study. *J Pediatr Surg* 2021; 56: 1791-1798.
22. Ruttenstock E, Puri P. Systematic review and meta-analysis of enterocolitis after one-stage transanal pull-through procedure for Hirschsprung's disease. *Pediatr Surg Int* 2010; 26: 1101-1107.
23. De la Torre L, Langer JC. Transanal endorectal pull-through for Hirschsprung disease: technique, controversies, pearls, pitfalls, and management of postoperative obstructive symptoms. *J Pediatr Surg* 2010; 45: 1-9.
24. Ho Tran Ban, Vuong Minh Chieu, Quynh Thi Vu Huynh, Thanh TT, Quang DT, Uy LTN. Long-term outcomes of laparoscopic-assisted versus complete transanal endorectal pull-through technique for Hirschsprung's disease. *Pediatr Surg Int* 2025; 41: 26.
25. Mueller JL, Hotta R. Current and future state of the management of Hirschsprung disease. *World J Pediatr Surg* 2025; 8: e000860.