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# FUNCTIONAL OUTCOMES AFTER TERPT VS LAPAROSCOPIC-ASSISTED TERPT IN SHORT-SEGMENT HIRSCHSPRUNG'S DISEASE

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**Abstract**

This study aimed to evaluate postoperative functional outcomes in children with short-segment Hirschsprung's disease (HD) following transanal endorectal pull-through (TERPT) and laparoscopically assisted TERPT (L-TERPT). We retrospectively analyzed 72 patients who underwent minimally invasive surgery for short-segment HD at the Department of Pediatric Surgery, Educational-Surgical Clinic of Azerbaijan Medical University between 2014 and 2025. Thirty patients underwent TERPT, and 42 underwent L-TERPT. Functional outcomes were assessed over a median follow-up of 36 months (IQR, 18–60) using the Rintala Bowel Function Score (BFS), bowel movement frequency (BMF), and the severity of constipation and fecal incontinence according to the Krickenbeck classification. The incidence of postoperative Hirschsprung-associated enterocolitis (HAEC) was also evaluated. Most patients in both groups achieved good to normal bowel function. While most outcomes were comparable between TERPT and L-TERPT, postoperative constipation was significantly less frequent in the L-TERPT group ($p = 0.032$). No significant differences were observed in BFS, bowel movement frequency, fecal incontinence, or postoperative HAEC. Postoperative complications were associated with patient-specific and perioperative factors rather than the surgical technique. Both TERPT and L-TERPT appear to be safe and effective minimally invasive procedures for treating short-segment HD, with favorable long-term functional outcomes.

**Keywords:** Hirschsprung's disease; transanal endorectal pull-through; laparoscopically assisted transanal endorectal pull-through; functional outcomes; fecal incontinence

## INTRODUCTION

Hirschsprung's disease (HD) is a rare congenital disorder with an estimated incidence of approximately 1 in 5,000 live births [1,2]. It is characterized by the absence of parasympathetic ganglion cells in the submucosal (Meissner), deep submucosal (Henle), and myenteric (Auerbach) plexuses of the distal intestine, resulting in a functional intestinal obstruction due to an aperistaltic segment [1,3].

HD is most commonly diagnosed within the first year of life. Neonates typically present with delayed passage of meconium, progressive abdominal distension, and bilious vomiting, while older infants and children frequently exhibit chronic

constipation, dependence on rectal stimulation or enemas, recurrent episodes of Hirschsprung-associated enterocolitis (HAEC), and growth failure [7].

Based on the extent of aganglionosis, HD is classified as short-segment, long-segment, total colonic aganglionosis, or, rarely, total intestinal aganglionosis [4,10]. The aganglionic segment is aperistaltic, leading to proximal bowel dilation, fecal stasis, bacterial overgrowth, and a higher risk of enterocolitis. Untreated HD may result in growth retardation, neurodevelopmental delay, recurrent HAEC, and potentially life-threatening complications such as colonic perforation. Early diagnosis and timely surgical intervention are therefore essential [8].

Over the past decades, minimally invasive surgical techniques have largely replaced conventional open procedures. In particular, transanal endorectal pull-through (TERPT) and laparoscopically assisted transanal endorectal pull-through (L-TERPT) have become standard approaches in many centers [1,4–6]. Compared with open surgery, these techniques are associated with reduced surgical trauma, shorter hospital stay, decreased postoperative pain, faster recovery, and improved cosmetic outcomes [4–6].

TERPT is primarily indicated for patients with short-segment HD, especially in younger children. By avoiding abdominal access, this technique minimizes intra-abdominal contamination and reduces the risk of postoperative adhesions [1,9,10]. When performed with careful attention to pelvic anatomy, the risk of injury to surrounding structures is low, and both functional and cosmetic outcomes are generally favorable.

L-TERPT can be applied across a broader age range and is suitable for both short- and long-segment disease. Laparoscopic assistance enables intraoperative mapping biopsies, precise identification of the transition zone, adequate mobilization of the colon under direct visualization, and early detection of intra-abdominal complications such as bleeding or bowel torsion [5,9]. These advantages may be particularly relevant in cases with an uncertain transition level or proximal disease extension.

Despite their widespread use, comparative data on long-term functional outcomes remain inconsistent. Existing studies frequently combine short- and long-segment disease, include heterogeneous age groups, or use non-standardized outcome measures. Consequently, the relative impact of TERPT versus L-TERPT on bowel function, fecal continence, constipation, and HAEC—particularly in short-segment HD—remains unclear.

As short-segment HD is the most prevalent phenotype, procedure-specific outcome data in this subgroup are critical for informing operative strategy and family counseling. Therefore, this study aimed to compare long-term functional outcomes and HAEC incidence following TERPT and L-TERPT in children with short-segment HD. We hypothesized that both techniques would result in comparable long-term

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profiles of bowel function and complications.

## MATERIALS AND METHODS

This retrospective, non-randomized cohort study was conducted at the Department of Pediatric Surgery, Educational-Surgical Clinic of Azerbaijan Medical University, between January 2014 and December 2025. The study included children diagnosed with short-segment Hirschsprung's disease (HD) who underwent minimally invasive definitive surgery during the study period.

Short-segment HD was defined as aganglionosis limited to the rectum or rectosigmoid colon, confirmed by histopathological examination and intraoperative findings. Patients who required a protective stoma prior to definitive surgery were excluded to ensure cohort homogeneity.

A total of 72 patients met the inclusion criteria. Patients were stratified according to the surgical technique performed: transanal endorectal pull-through (TERPT, n = 30) and laparoscopically assisted transanal endorectal pull-through (L-TERPT, n = 42). The choice of surgical approach was determined based on institutional practice and surgeon discretion, which may introduce allocation bias.

Demographic and baseline clinical characteristics were collected from medical records, including gender, age at surgery, body weight, and nutritional status. Nutritional status was assessed using the weight-for-age z-score (WAZ). A family history of HD was documented in three patients, and parental consanguinity was recorded in four cases. One patient in the TERPT group had Mowat–Wilson syndrome, and one patient in the L-TERPT group underwent surgery during remission from acute leukemia.

All patients underwent standardized preoperative assessment, including plain abdominal radiography, abdominal ultrasonography, contrast enema studies, and routine laboratory investigations. In diagnostically equivocal cases, full-thickness colonic biopsies were performed to confirm aganglionosis histopathologically (n = 20).

Preoperative Hirschsprung-associated enterocolitis (HAEC) episodes were recorded. HAEC was diagnosed based on established clinical criteria, including abdominal distension, fever, explosive diarrhea, lethargy, and radiological findings suggestive of colonic inflammation. In equivocal cases, laboratory findings such as leukocytosis and elevated inflammatory markers, in conjunction with imaging studies, supported the diagnosis. Episodes were categorized as preoperative or postoperative according to their temporal relationship to definitive surgery. All patients with preoperative HAEC received standardized management consisting of metronidazole therapy, synbiotic supplementation, and regular rectal irrigations prior to surgery.

All procedures were performed by experienced pediatric surgeons according to standardized institutional protocols. TERPT was performed using a transanal endorectal dissection technique without abdominal access. In the L-TERPT group, laparoscopic assistance was used for intraoperative mapping biopsies, transition zone identification, and colonic mobilization prior to transanal pull-through.

### *Functional Assessment*

Postoperative functional outcomes were evaluated over a median follow-up period of 36 months (interquartile range [IQR]: 18–60 months). Data were obtained through structured parental interviews, outpatient clinic assessments, and retrospective

review of medical records. Parental interviews were conducted using a standardized questionnaire designed to capture bowel habits, continence, and episodes of HAEC.

Bowel function was assessed using the Rintala Bowel Function Score (BFS; range, 0–20). In accordance with the original validation, scores ≥12 were considered indicative of normal bowel function. For analytical purposes, outcomes were categorized as poor (0–7), moderate (8–11), and good (12–20). Scoring was performed by a trained pediatric surgical research fellow who was not involved in the operative procedures to minimize observer bias.

Postoperative constipation and fecal incontinence were evaluated according to the Krickenbeck classification. Constipation was graded as I–III based on the need for dietary modifications, laxatives, or enemas, whereas fecal incontinence was graded according to frequency and social impact. Defecation frequency was recorded as the number of bowel movements per day based on parental reports.

Postoperative HAEC was documented throughout the follow-up period and classified as recurrent (in patients with preoperative HAEC) or de novo (first-time postoperative episodes). HAEC diagnosis was based on established clinical criteria, including abdominal distension, fever, explosive diarrhea, lethargy, and radiological findings indicative of colonic inflammation. Only clinically significant episodes requiring medical intervention were included.

### *Statistical Analysis*

Statistical analyses were performed using IBM SPSS Statistics (version 27; IBM Corp., USA). Continuous variables were expressed as medians with interquartile ranges (IQRs) and compared between groups using the Mann–Whitney U test. Categorical variables were analyzed using the chi-square ($\chi^2$) test with Yates' continuity correction. All tests were two-tailed, and a p-value < 0.05 was considered statistically significant [11].

## RESULTS

### Baseline Characteristics

A total of 72 patients with short-segment HD were included, with 30 patients undergoing TERPT and 42 undergoing L-TERPT. Baseline demographic and clinical characteristics are summarized in Table 1.

There were no significant differences between the groups regarding age at surgery, gender distribution, weight at surgery, nutritional status (weight-for-age z-score, WAZ), family history of HD, parental consanguinity, or associated anomalies (all $p > 0.05$). Preoperative HAEC was more common in the TERPT group (40%) compared to the L-TERPT group (19%), although this difference approached statistical significance ($p = 0.052$).

**Table 1. Baseline clinical and demographic characteristics of patients with short-segment HD**

| **Characteristics** | **TERPT (n=30)** | **L-TERPT (n=42)** | ***p-value*** |
|---|---|---|---|
| Age at surgery, month (median, IQR) | 17.5 (12.0–25.0) | 20.0 (9.0–28.0) | 0.571 |
| Gender, n (%)<br>male<br>female | <br>18 (60.0)<br>12 (40.0) | <br>25 (59.5)<br>17 (40.5) | 0.968 |

| | | | |
|---|---|---|---|
| Weight at surgery, kg (median, IQR) | 10.0 (8.3–12.0) | 11.0 (8.0–12.0) | 0.736 |
| Malnutrition (WAZ), (median, IQR) | –0.3 (–1.0 to +0.8) | –0.7 (–1.2 to –0.2) | 0.065 |
| Preoperative HAEC, n (%) | 12 (40.0) | 8 (19.0) | 0.052 |
| Family history of HD, n (%) | 2 (6.7) | 1 (2.4) | 0.373 |
| Parental consanguinity, n (%) | 2 (6.7) | 2 (4.8) | 0.730 |
| Comorbidity, n (%) | 1 (3.3) | 1 (2.4) | 0.810 |

*Note: Continuous variables are presented as median (IQR), and categorical variables as n (%). The Mann–Whitney U test was used for comparisons.*
*HAEC = Hirschsprung-associated enterocolitis; WAZ = weight-for-age z score.*

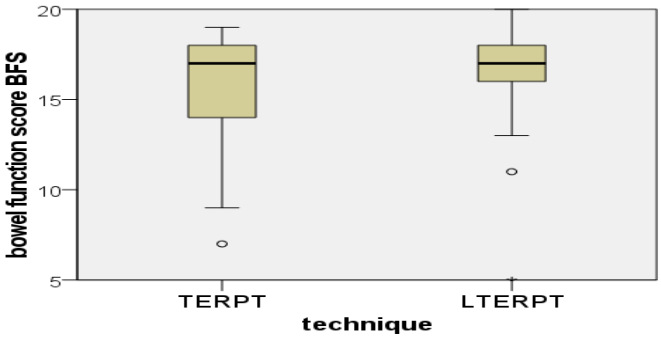
**Perioperative Outcomes**

One L-TERPT case required conversion to open surgery due to technical difficulties with bowel mobilization. In the TERPT group, one patient developed postoperative anastomotic stenosis refractory to conservative dilatation and subsequently underwent repeat TERPT.

**Functional Bowel Outcomes**

Postoperative functional outcomes were evaluated over a median follow-up of 36 months (IQR: 18–60). According to the Rintala Bowel Function Score (BFS), most patients in both groups achieved good bowel function (Table 2).

**Table 2. Postoperative Rintala Bowel Function Score (BFS) distribution**




The median BFS was similar between groups: 17.0 (IQR: 14.0–18.0) in the TERPT group and 17.0 (IQR: 16.0–18.0) in the L-TERPT group ($p > 0.05$). The “good” category was the most frequent outcome, observed in 86.7% of TERPT and 95.2% of L-TERPT patients. Poor functional outcomes were rare, occurring in only one patient in each group.

Krickenbeck classification demonstrated high rates of voluntary bowel movements in both groups (93.3% TERPT vs 97.6% L-

TERPT). Fecal incontinence was infrequent and did not differ significantly between groups, whereas postoperative constipation was less common in the L-TERPT group, and this difference reached statistical significance (Table 3).

**Table 3. Assessment of postoperative bowel function using the Krickenbeck classification**

| **Functional Indicators** | **TERPT (n=30), n (%)** | **L-TERPT (n=42), n (%)** | ***p-value*** |
|---|---|---|---|
| Voluntary bowel movements | | | 0.373 |
| Yes | 28 (93.3) | 41 (97.6) | |
| No | 2 (6.7) | 1 (2.4) | |
| Fecal incontinence | | | 0.400 |
| No | 27 (90) | 40 (95.2) | |
| Grade I | 2 (6.7) | 1 (2.4) | |
| Grade II | 1 (3.3) | 1 (2.4) | |
| Grade III | 0 (0) | 0 (0) | |
| Constipation | | | 0.032* |
| No | 25 (83.3) | 41 (97.6) | |
| Grade I | 1 (3.3) | 0 (0) | |
| Grade II | 3 (10) | 1 (2.4) | |
| Grade III | 1 (3.3) | 0 (0) | |

***Note:*** *Statistical comparisons were performed using the Mann–Whitney U test.*
** – The null hypothesis is rejected.*

## Postoperative Hirschsprung-Associated Enterocolitis

Postoperative HAEC occurred in 16.7% of TERPT and 7.1% of L-TERPT patients, with the majority occurring in those with preoperative HAEC (Table 4). Recurrent HAEC was observed in three TERPT patients and one L-TERPT patient, while de novo HAEC occurred in two patients in each group. There were no significant differences in the incidence of postoperative HAEC between the surgical approaches ($p > 0.05$).

**Table 4. Postoperative Hirschsprung-associated enterocolitis (HAEC) by groups**

| **HAEC Indicators** | **TERPT (n=30), n(%)** | **L-TERPT(n=42), n(%)** | ***p-value*** |
|---|---|---|---|
| History of preoperative HAEC | | | 0.052 |
| Yes | 12 (40.0) | 8 (19.0) | |
| No | 18 (60.0) | 34 (81.0) | |
| Postoperative HAEC | | | 0.208 |
| Yes | 5 (16.7) | 3 (7.1) | |
| No | 25 (83.3) | 39 (92.9) | |

***Note:*** *P-values were calculated using the Mann–Whitney U test.*

## DISCUSSION

The present study demonstrates that both transanal endorectal pull-through (TERPT) and laparoscopically assisted TERPT (L-TERPT) provide satisfactory long-term functional outcomes in the majority of children with short-segment Hirschsprung's disease (HD). The high proportion of patients achieving BFS ≥12 indicates that both procedures restore socially acceptable bowel function in most cases. These findings further support the effectiveness and reliability of minimally invasive approaches for this patient population.

A notable finding of this study was the significantly lower rate of postoperative constipation in the L-TERPT group compared to the TERPT group. The lower constipation rate observed in the L-TERPT group may reflect improved intraoperative visualization and more accurate identification of the transition zone, reducing the risk of residual dysmotility. Laparoscopic assistance allows precise mapping biopsies and better mobilization of the colon, which may contribute to these functional advantages.

Fecal incontinence was an uncommon postoperative complication, occurring in two patients in the TERPT group and one patient in the L-TERPT group. In all cases, incontinence was attributable to complex clinical factors rather than the surgical technique itself. Specifically, in the TERPT group, one patient developed incontinence following repeat surgery for anastomotic stenosis, and another had severe hypotrophy associated with Mowat–Wilson syndrome. In the L-TERPT group, incontinence occurred after early postoperative anastomotic leakage necessitating reoperation. These observations suggest that postoperative functional complications are more strongly influenced by patient-specific factors, comorbidities, and adverse perioperative events than by the choice of surgical approach. Such factors should be carefully considered when interpreting outcomes and counseling families.

Previous literature has reported that fecal incontinence after pull-through procedures may result from technical factors, including potential injury to the anal sphincter complex, impaired anorectal sensation, and altered bowel motility following resection [1,5]. Excessive intraoperative anal dilation has also been implicated, although these effects are typically transient [5,6]. Meticulous surgical technique, particularly accurate placement of the anastomosis proximal to the dentate line, remains critical to minimize postoperative dysfunction [1].

Preoperative Hirschsprung-associated enterocolitis (HAEC) was more prevalent in the TERPT group, which may reflect the younger age of these patients. Younger children are known to be at higher risk for HAEC, likely due to immaturity of the enteric nervous system [3,6]. Although postoperative HAEC occurred slightly more frequently in the TERPT group, this difference was not statistically significant. The absence of a significant difference suggests that enterocolitis risk is primarily driven by intrinsic disease factors and postoperative bowel adaptation rather than the surgical technique. This finding underscores the multifactorial nature of HAEC, including the influence of patient characteristics and preoperative disease burden.

Recent systematic reviews and meta-analyses published between 2023 and 2024 report comparable long-term functional outcomes between TERPT and L-TERPT in short-segment HD. These studies indicate that rates of constipation, fecal incontinence, and HAEC recurrence are primarily determined by patient-related factors and perioperative management rather than the specific minimally invasive

approach employed [5,7]. Our findings are consistent with these contemporary data, supporting the equivalence of TERPT and L-TERPT in appropriately selected patients.

**Study limitation**

Several limitations of this study should be acknowledged. First, its retrospective, single-center design and relatively small sample size may limit external validity. Selection bias due to non-random allocation of patients to TERPT or L-TERPT may have influenced the observed outcomes, as the choice of surgical technique was based on surgeon discretion. No formal sample size calculation was performed, and the study may be underpowered to detect small differences between groups. Second, the absence of multivariate analysis precludes identification of independent predictors of functional outcomes. Third, the use of parental reports for functional assessment may introduce reporting bias. These limitations warrant cautious interpretation of the results and highlight the need for prospective, multicenter studies.

**Conclusion**

Both TERPT and L-TERPT provide favorable and comparable long-term functional outcomes in children with short-segment Hirschsprung's disease. While overall bowel function, continence, and HAEC incidence were similar, L-TERPT was associated with a significantly lower rate of postoperative constipation. These findings suggest that surgical technique plays a limited role in determining long-term outcomes, which are more strongly influenced by patient-specific factors and perioperative management. Prospective, multicenter studies with multivariate analysis are needed to confirm these results.

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## *QISA SEQMENTLİ HİRSPRUNG XƏSTƏLİYİNDƏ TERPT VƏ LAPAROSKOPİK DƏSTƏKLƏ TERPT: FUNKSİONAL NƏTİCƏLƏRİN TƏHLİLİ*

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**Xülasə**

Tədqiqatın məqsədi uşaqlarda qısa seqmentli Hirşprunq xəstəliyinin (HX) minimal invaziv cərrahi müalicə üsulları olan transanal endorektal endirilmə (TERPT) və laparoskopik dəstəklə transanal endorektal endirilmə (L-TERPT) əməliyyatlarından sonra funksional nəticələrin müqayisəli şəkildə qiymətləndirilməsidir. Retrospektiv tədqiqat işinə 2014-2025-ci illərdə Azərbaycan Tibb Universitetinin Tədris-Cərrahiyyə Klinikası Uşaq cərrahiyyəsi şöbəsində "Qısa seqmentli Hirşprunq xəstəliyi" diaqnozu ilə minimal invaziv cərrahi müdaxilə aparılmış 72 xəstə daxil edilmişdir. 30 xəstədə TERPT, 42 xəstədə isə L-TERPT əməliyyatı icra olunmuşdur. Funksional nəticələr 36 ay median izləmə müddəti (IQR 18–60 ay) ərzində Rintala bağırsaq funksiyası şkalası (Rintala Bowel Function Score, BFS), defekasiya tezliyi (BMF), həmçinin Krikkenbek təsnifatına əsasən qəbizlik və nəcis inkontinensiyasının ağırlıq dərəcəsi üzrə qiymətləndirilmişdir. Həmçinin Hirşprunq xəstəliyinə bağlı əməliyyatdan sonrakı enterokolitin (HAEC) rast gəlmə tezliyi və yaranma səbəbləri müqayisəli şəkildə təhlil edilmişdir.Hər iki qrupda xəstələrin əksəriyyətində bağırsaq funksiyası yaxşı və ya normal səviyyədə müşahidə edilmişdir. TERPT və L-TERPT qrupları arasında BFS, BMF, nəcis saxlamazlığı və postoperativ HAEC baxımından statistik olaraq əhəmiyyətli fərq müşahidə edilməmişdir ($p > 0,05$), lakin postoperativ qəbizlik L-TERPT qrupunda statistik olaraq daha az olmuşdur ($p = 0,032$). Postoperativ ağırlaşmalar nadir hallarda müşahidə olunmuş və daha çox xəstəyə aid fərdi xüsusiyyətlər və perioperativ amillərlə əlaqəli olmuşdur, cərrahi texnikadan isə asılılığı az olmuşdur. Həm TERPT, həm də L-TERPT qısa seqmentli Hirşprunq xəstəliyinin müalicəsində təhlükəsiz, effektiv və etibarlı minimal invaziv cərrahi üsullar olub, uzunmüddətli funksional nəticələr baxımından bir-biri ilə müqayisəolunan nəticələr göstərmişdir.

**Açar sözlər:** Hirşprunq xəstəliyi, transanal endorektal endirilmə, laparoskopik köməklə transanal endorectal endirilmə, nəcis inkontinensiyası

## *ФУНКЦИОНАЛЬНЫЕ РЕЗУЛЬТАТЫ ПОСЛЕ TERPT ПО СРАВНЕНИЮ С ЛАПАРОСКОПИЧЕСКИ АССИСТИРОВАННОЙ TERPT ПРИ КОРОТКОМ СЕГМЕНТЕ БОЛЕЗНИ ГИРШПРУНГА*

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***Резюме***

Целью данного исследования было оценить послеоперационные функциональные результаты у детей с коротким сегментом болезни Гиршпрунга (БГ) после трансанаального эндоректального низведения (TERPT) и лапароскопически ассистированного трансанаального эндоректального низведения (L-TERPT). Проведён ретроспективный анализ 72 пациентов, которым были выполнены минимально инвазивные хирургические вмешательства по поводу короткого сегмента БГ в отделении детской хирургии Учебно-хирургической клиники Азербайджанского Медицинского Университета в период с 2014 по 2025 год. Тридцати пациентам было выполнено TERPT, а сорока двум — L-TERPT. Функциональные результаты оценивались в течение медианного периода наблюдения 36 месяцев (IQR 18–60 месяцев) с использованием шкалы функции кишечника Ринтала (Rintala Bowel Function Score, BFS), частоты дефекаций (BMF), а также степени выраженности запоров и недержания кала согласно классификации Криккенбека. Также была проанализирована частота послеоперационного энтероколита, ассоциированного с болезнью Гиршпрунга (HAEC). У большинства пациентов в обеих группах отмечена хорошая или нормальная функция кишечника. Хотя большинство показателей были сопоставимы между группами TERPT и L-TERPT, послеоперационные запоры встречались статистически значительно реже в группе L-TERPT (p = 0,032). Статистически значимых различий по шкале функции кишечника Ринталы (BFS), частоте дефекаций, фекальной инконтиненции или послеоперационному энтероколиту, связанному с болезнью Гиршпрунга (HAEC), не выявлено. Послеоперационные осложнения наблюдались редко и в большей степени были связаны с индивидуальными характеристиками пациентов и периоперационными факторами, нежели с типом хирургической техники. Оба метода — TERPT и L-TERPT — являются безопасными, эффективными и надёжными минимально инвазивными хирургическими вмешательствами при лечении короткого сегмента болезни Гиршпрунга и обеспечивают сопоставимые отдалённые функциональные результаты.

**Ключевые слова:** болезнь Гиршпрунга; трансанальное эндоректальное низведение; лапароскопически ассистированное трансанальное эндоректальное низведение; функциональные результаты; недержание кала