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# Prophylactic versus symptomatic Ladd procedures for pediatric malrotation



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## ABSTRACT

**Background:** Intestinal malrotation can lead to volvulus resulting in necrosis, sepsis, and death. For symptomatic patients, treatment includes the Ladd procedure. However, debate remains regarding the timing and need for intervention for asymptomatic infants. We evaluated our experience with Ladd procedures including a clinical practice of prophylactic surgery for asymptomatic patients.

**Materials and methods:** A retrospective review of pediatric patients undergoing the Ladd procedure was performed. Prophylactic Ladd procedures were identified as those occurring before any malrotation-related symptoms. Results were analyzed with student t test, Mann–Whitney U, and chi-squared tests.

**Results:** From 2011–2014, 42 patients (prophylactic = 19, symptomatic = 23) underwent the Ladd procedure. The median age (IQR, interquartile range) of patients was 9.6 (3.9–18) mo and 18 (2.4–52) mo for prophylactic and symptomatic patients, respectively ( $P = 0.38$ ). In patients who underwent symptomatic Ladd procedures, nine (39%) had volvulus and one (4.3%) had bowel necrosis at time of surgery. No prophylactic Ladd procedure patients required reoperation, whereas six (26%) symptomatic patients required malrotation-related reoperations ( $P = 0.02$ ). Median (IQR) days to full enteral feeds were 5.0 d (3.3–6.8) versus 7.4 (5.0–11;  $P = 0.11$ ), whereas median days to discharge were 8.0 d (6.1–11) versus 11 d (7.5–32) until discharge ( $P = 0.09$ ) for prophylactic and symptomatic patients, respectively.

**Conclusions:** Although symptomatic patients represent sicker children, the postoperative complications appear to be higher. For infants with known malrotation, prophylactic operations may be beneficial and should be considered. A larger, prospective study to demonstrate effectiveness and generalizability for prophylactic Ladd procedure is warranted.

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## Introduction

Malrotation of the intestines, occurring during embryogenesis, is a potentially deadly congenital defect.<sup>1</sup> Although the actual prevalence of malrotation is hard to ascertain, it is estimated at one in 500 births.<sup>2</sup> Malrotation predisposes the patient to intestinal volvulus, a life-threatening condition that may result in intestinal ischemia, leading to necrosis, sepsis, and death.<sup>2-5</sup>

Although treatment is obvious for symptomatic patients, controversy exists regarding the need and timing of operation for asymptomatic children.<sup>6</sup> A Ladd procedure is performed on symptomatic patients. The Ladd procedure is a surgical correction of malrotation. During the operation, any volvulus, if present, is de-torsed, aberrant adhesive bands between the cecum and right abdominal wall-called Ladd's bands, are divided, the base of the mesentery is broadened, and an appendectomy is performed.<sup>7</sup>

Elective surgery reduces the likelihood of emergency surgery, which is shown to have higher a complication rate, but it is not without risk. These patients are generally younger and often suffer comorbidities, which must be considered with the increased lifetime risk of adhesive bowel obstruction. Watchful waiting, on the other hand, leaves the patient susceptible to volvulus and emergency operations, though the frequency of asymptomatic cases becoming symptomatic is unknown. There has been no longitudinal observation study of known patients with malrotation.

In response to an increase in known intestinal malrotation associated with prenatally diagnosed heterotaxy syndrome (HS), a clinical practice guideline was introduced in late 2010 that standardized the prophylactic surgical management of children with asymptomatic malrotation. We sought to evaluate our clinical practice of prophylactic Ladd procedures compared to symptomatic Ladd procedures with regard to time to full enteral feeds, length of stay, and postoperative complications.

## Materials and methods

### Study design and setting

A retrospective study was conducted of all patients undergoing a Ladd procedure at an academic tertiary children's

hospital between 2011 and 2014. Institutional review board approval (HSC-MS-15-0419) was obtained before initiating the study. Patient data were collected by reviewing inpatient and outpatient electronic medical records. Patients were identified using the Current Procedural Terminology code 44,055 for the Ladd procedure. All patients who underwent a Ladd procedure, all open cases, during the study period were included.

Malrotation was confirmed before surgery by radiologic imaging. Radiologic imaging included upper gastrointestinal fluoroscopy (UGI), ultrasound (U/S), computed tomography (CT), magnetic resonance imaging (MRI), barium enema (BE), and abdominal radiograph (XR). Patients were defined as having a prophylactic procedure if the only indication for surgery was related to intestinal malrotation. Patients were defined as having a symptomatic procedure if they had the surgery done after symptoms were experienced and confirmed by imaging. Symptoms included feeding intolerance, emesis ( $\pm$ bilious), abdominal pain, abdominal distension, constipation, and/or obstipation.

### Data acquisition and analysis

We collected data on patient demographics, including gender, age, and weight at surgery, and comorbid congenital heart defects (CHDs), as well as the method of diagnosis. CHDs were divided into major and minor categories using the definitions found in the American College of Surgeons National Surgical Quality Improvement Pediatric Operations Manual.<sup>8</sup> The circumstances of surgery (urgent versus elective) and findings at surgery (volvulus, necrosis) were also recorded. Finally, post-surgical outcomes data were gathered, including time to full enteral feeds, time to discharge, readmissions, reoperations, deaths, and follow-up time. Full enteral feeds were defined as withdrawal of parenteral feedings, with reliance solely on enteral feeds, whether by mouth, or via gastrostomy tube. Statistical analysis was performed with Student t test, Mann-Whitney U and chi-squared tests. P values <0.05 were considered statistically significant. All statistical analyses were performed using Stata, 13.1 (College Station, Texas).

## Results

Forty-two patients who had Ladd procedures for intestinal malrotation between 2011 and 2014 were identified. Nineteen

**Table 1 – Patient demographics.**

	Prophylactic Ladd's (n = 19)	Symptomatic Ladd's (n = 23)	P value
Age at operation, median, mo (IQR)	0.8 (0.3-1.5)	1.5 (0.2-52)	0.38
Male gender, n (%)	12 (52.2)	11 (57.9)	0.70
Weight at operation, median kg (IQR)	3.1 (2.8-3.5)	4.6 (3.3-19)	0.01
Congenital heart defect, n (%)	17 (89)	3 (10)	<0.01
Major	9	2	<0.01
Minor	8	1	<0.01

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