

# Unilateral Versus Bilateral Wrap Crural Fixation in Laparoscopic Nissen Fundoplication for Children

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## ABSTRACT

**Introduction:** Gastroesophageal reflux (GERD) is common in neurologically impaired (NI) children. Fundoplication and gastrostomy have previously been indicated in NI children with GERD who have not responded to medical treatment. The most common reason for fundoplication failure is intrathoracic migration of the wrap.

**Objective:** The aim of the study is to measure the effect of wrap fixation on the final outcome of laparoscopic Nissen fundoplication in NI children.

**Patients and Methods:** A retrospective file review was conducted for all NI children who underwent laparoscopic Nissen fundoplication in 2 tertiary pediatric surgery centers in the United Arab Emirates from February 15, 2006 to February 15, 2013. Redo fundoplication patients were excluded from the study. Patients were divided into 2 groups: group 1 in which the fundoplication wrap was fixed to the right crus only, and group 2 in which the wrap was fixed to the right and left crus simultaneously.

**Results:** The study population included 68 patients; there were 47 male and 21 female children. Mean age at time of surgery was 8.2 years. Recurrent GERD at 1 year postoperatively was 26% versus 7% in group 1 and group 2, respectively, by upper contrast study. Redo surgery was required in 21% versus 3% in group 1 and group 2, respectively.

**Conclusions:** Bilateral fixation of the wrap to diaphragmatic crura significantly reduced recurrent GERD, in laparoscopic Nissen fundoplication for neurologically impaired children, with no increased risk of morbidities. Future prospective studies should be conducted

with larger patient populations and longer follow-up periods.

**Key Words:** Children, Fundoplication, Neurological impairment, Wrap.

## INTRODUCTION

Gastroesophageal reflux (GERD) is common in neurologically impaired (NI) children.<sup>1,2</sup>

Fundoplication and gastrostomy has previously been indicated in NI children with GERD who have not responded to medical treatment. In neurologically normal (NN) children, surgical treatment is successful in 90% of patients, but in NI children, the failure rate is reported to be rather high.<sup>3,4</sup>

The prevalence of comorbidities, such as spasticity, epilepsy, and scoliosis are higher in NI children. These factors may explain why they are prone to recurrent GERD after fundoplication.<sup>5</sup> The efficacy of fundoplication in severely NI children has been doubted. Morbidity, mortality, and recurrence rates are higher than those reported in NN children.<sup>5,6</sup>

The most common reason for fundoplication failure is intrathoracic migration of the wrap, leading to recurrent GERD symptoms in adults and children.<sup>7,8</sup>

Although children with NI are the ones who are in greatest need for the Nissen fundoplication procedure, scant attention has been paid in the literature to the surgical details and the outcomes of this procedure for this subgroup of patients.<sup>9-12</sup>

The aim of the study is to measure the effect of unilateral versus bilateral wrap fixation to diaphragmatic crura on the final outcome of laparoscopic Nissen fundoplication in NI children.

## PATIENTS AND METHODS

A retrospective file review was conducted for all NI children, who were operated on for laparoscopic Nissen fundoplication, in 2 pediatric surgery tertiary centers in the

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United Arab Emirates from February 15, 2006 to February 15, 2013.

Patients with redo fundoplication and NI without brain insult were excluded from the study.

A total of 103 patients were operated on for laparoscopic Nissen fundoplication during the study period, 68 of them were neurologically impaired according to the study criteria.

Patients were divided into 2 groups: group 1 (38 patients) in which the fundoplication wrap was fixed to the right crus only, and group 2 (30 patients) in which the wrap was fixed to the right and left crus simultaneously. Group 1 and group 2 patients were treated in the periods from February 2006 to June 2010 versus July 2010 to February 2013, respectively.

The following data were collected: demographics of the patients, cause of neurological impairment, indications for surgery, operative time, intraoperative complications, postoperative recurrence of preoperative symptoms, upper contrast study, and milk scan results at 1 year postoperatively.

The data were tabulated and analyzed and statistical significance was calculated using SPSS (version 17; IBM, Armonk, New York). Chi square and *t* tests were calculated to test for the significant differences between the groups; *P* < .05 was considered a statistically significant difference.

### Perioperative Management

Upper gastrointestinal contrast study was performed for all the patients in the study to delineate any anatomical abnormalities including the presence of GERD.<sup>13</sup> The diagnosis of GERD was confirmed by 24-hour pH monitoring in 45 patients (66%). For patients who did not tolerate the 24-hour pH study (23 patients, 34%), a milk scan was used with 24-hour late lung images to reveal pulmonary aspiration.

All the patients received a preoperative single dose of amoxicillin/clavulanic acid and glycerin enema twice daily 24 hours before surgery.

**Surgical technique.** Both groups were operated on using a standardized surgical technique, and a total of 4 laparoscopic 5-mm or 3-mm ports were used. The liver was retracted by Nathanson liver retractor (Cook Medical Inc, Bloomington, Indiana) inserted into the subxiphisternal area.

The short gastric vessels were divided in all the cases; approximation of the crura were done with 2/0 polyester nonabsorbable suture with a stent placed in the esophagus; and no pledgets or mesh were used. Short, floppy Nissen fundoplication was created using 2/0 polyester suture. In group 1, the first stitch for fundoplication incorporated the fundus, the esophagus, and the right diaphragmatic crus in the wrap, while in group 2, the first stitch was done as in group 1 and an extra stitch was used, after the completion of the fundoplication, to fix the top of the wrap to the left crus (**Figure 1**). All the patients in the study had a gastrostomy placed concomitantly with fundoplication.

Postoperatively, the antibiotic and ondansetron were continued for 24 hours. Oral proton pump inhibitor was continued for 2 weeks postoperatively. Gastrostomy feeding was started 24 hours after surgery.

All the patients underwent 1-year postoperative upper contrast study and milk scan, regardless of their clinical outcome, to define the anatomy of the wrap and any recurrent GERD.

### RESULTS

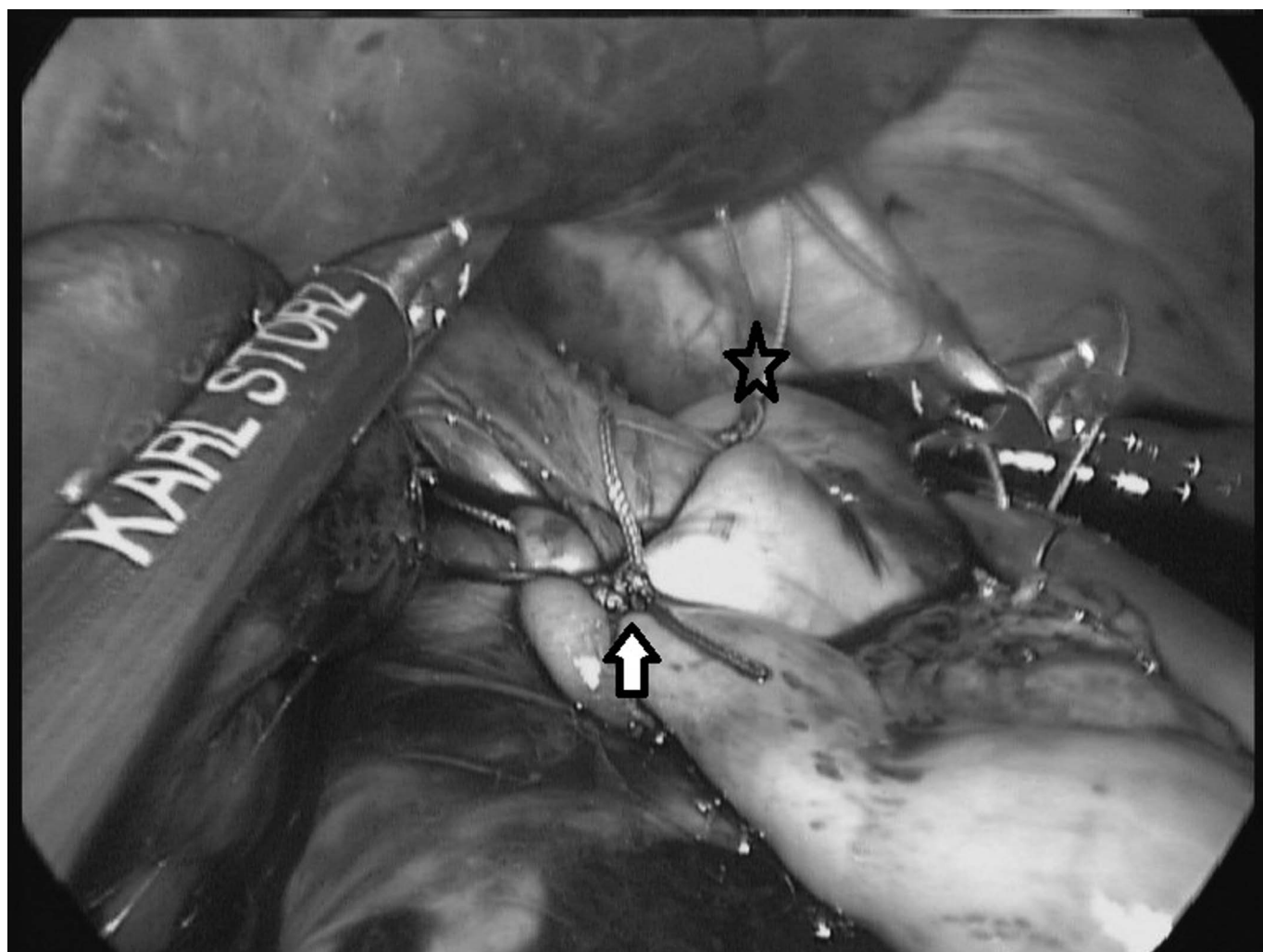
The study population included 68 patients; there were 47 male and 21 female children. Age at the time of surgery ranged from 4 years to 12 years (mean, 8.2 years).

Causes of NI included congenital and acquired cerebral palsy, as well as metabolic and genetic diseases. Sixty patients (88%) were nonambulatory, incontinent, and nonverbal at the time of surgery.

**Table 1** shows the indications of surgery, aspiration pneumonia was the most common indication for fundoplication and gastrostomy in both groups. The preoperative upper contrast study revealed 11 patients (16%) with hiatal hernia in both groups (11 vs 5 patients presented clinically with aspiration pneumonia vs persistent emesis, respectively).

There were no intraoperative complications in the study population. The average postoperative hospital stay was 3.5 days for both groups. There was no in-hospital mortality; 5 patients (7%) died during the study period; and death was not related to the surgical intervention in any of the subjects.

There was no significant difference in the mean operative time: group 1's average time was  $150 \pm 30$  minutes compared with  $165 \pm 35$  minutes in group 2 ( $t = 1.9$ ,  $P > .05$ ).



**Figure 1.** Intraoperative image of the wrap. The arrow indicates the first stitch, which includes the fundus, the esophagus, and the right crus. The star indicates the stitch that fixes the wrap to the left crus.

**Table 1.**  
Indications for Fundoplication in Both Groups

Group	Indications of Surgery	Group 1 (n = 38)	Group 2 (n = 30)	$\chi^2$ , P Value
	Aspiration pneumonia	20 (52)	12 (40)	1.1, >.05
	Swallowing incoordination	9 (24)	10 (33)	0.8, >.05
	Persistent emesis	6 (16)	3 (10)	0.1, >.05
	Concomitant with tracheostomy	3 (8)	5(17)	0.5, >.05

Values are n (%).

Follow-up ranged from 1 to 4 years (mean, 2.5 years). At 1-year postoperative follow-up, 8 patients (21%) from group 1 required redo surgery for recurrent symptomatic GERD (4 patients with wrap herniation, 1 pa-

tient with slipped-down wrap, and 3 with no anatomical abnormalities), compared with 1 patient (with no anatomical abnormality) in group 2 (3%), as shown in **Table 2.**

**Table 2.**  
Results of Postoperative Upper Contrast Study, Milk Scan, and Postoperative Clinical Recurrence of GERD

Variables	Group 1 (n =38)	Group 2 (n = 30)	$\chi^2$ , P Value
Recurrent GERD at 1 year postoperatively by upper contrast study			
Wrap herniation	4 (10)	0	4.5, <.05
Wrap slipped down	1 (3)	0	
Negative anatomical abnormality	5 (13)	2 (7)	
Total	10 (26)	2 (7)	
Recurrent GERD at 1 year postoperatively by milk scan	13 (34)	3 (10)	5.5, <.05
1-year postoperative clinical GERD required redo fundoplication			
Recurrent aspiration pneumonia	5 (13)	1 (3)	0.9, > .05
Persistent emesis	3 (8)	0	0.9, > .05

Abbreviation: GERD, gastroesophageal reflux.

Values are n (%).

## DISCUSSION

There is considerable uncertainty regarding the optimal treatment when faced with the decision of fundoplication surgery versus antireflux medications for children with GERD and NI who are undergoing gastrostomy insertion.<sup>14</sup>

The antireflux effect of Nissen fundoplication was initially related to the structural alteration that increases the tone of the lower esophageal sphincter, lengthens the intra-abdominal esophagus, and tightens the crura.<sup>6</sup> It was proposed that fundoplication could result in decreased transient lower esophageal sphincter relaxation by decreasing the fundic volume and causing fundal denervation.<sup>6</sup>

The current study showed no statistically significant differences in the demographics of the patients, as well as the causes of NI and indications for fundoplication in both groups.

Prophylactic fundoplication with gastrostomy placement is still a controversial issue.<sup>14</sup> Although Kawahara et al<sup>15</sup> concluded, in their study, that gastroesophageal reflux and related symptoms rarely deteriorate to require additional treatment after gastrostomy placement in patients with NI, we are adopting the policy of prophylactic fundoplication with gastrostomy insertion in NI patients, in concordance with the study by Ponsky et al.<sup>16</sup>

The retrospective study by St Peter et al<sup>8</sup> has shown that placement of esophagocrural sutures and minimization of the dissection around the esophagus results in a >2-fold

reduction in the risk of wrap transmigration after laparoscopic Nissen fundoplication for NN and NI patients.

In the current study, no sutures were used to fix the esophagus to the crura directly, but the esophagus was fixed to the wrap and the wrap was fixed (unilaterally or bilaterally) to the crura. The degree of dissection around the esophagus was different in each case, the dissection was limited to achieve 2 cm of intra-abdominal esophagus and to give enough room for the wrap to pass behind the esophagus.

Based on the results of the current study, we believe that, fixation of the wrap to both crura decreases the incidence of recurrent GERD through 2 mechanisms. First, it secures the wrap from migrating up or down. Second, through decreasing the tension on the wrap sutures, it will prevent the wrap from becoming loose with time. Future prospective studies should be conducted to show more valid conclusions.

There was no statistically significant difference in the operative time in both groups, although it was longer in group 2. There were no intraoperative complications in our study, as well as no conversion or mortality related to the surgical intervention.

The success of the surgery can be assessed objectively with a barium swallow test, endoscopy, pH monitoring, and manometry.<sup>16</sup> We have used the barium swallow test as our routine follow-up investigation because it affords the necessary information at a reasonable cost and is considerably more acceptable to the patient than other

methods such as pH monitoring and/or endoscopy. Donkervoort et al<sup>17</sup> used barium swallow tests at 2 years postoperatively as part of their follow-up. Milk scan was used as well in all the cases 1 year postoperatively to give more accurate, objective data about the recurrence of GERD, aspiration pneumonia, and gastric emptying time.

Pimpalwar and Najmaldin<sup>18</sup> reported that the recurrence rate of GERD after laparoscopic fundoplication in NI patients was 16%, and some patients required a second laparoscopic fundoplication procedure. In the current study, recurrent GERD was statistically significantly higher in group 1 by upper contrast study as well as by milk scan.

Kawahara et al<sup>19</sup> studied the mechanism of operative failure in NI children. Wrap herniation, wrap slipped down to the stomach, and partial wrap disruption were identified in their study as a cause for recurrence. In concordance with the results of Kawahara et al,<sup>19</sup> analysis of the causes for recurrent GERD of upper contrast study revealed negative anatomical abnormality in 13% versus 7% of patients in group 1 and group 2, respectively, followed by wrap herniation (10%) and wrap slipped down to the stomach (3%) in group 1. There were no cases of wrap disruption in our study population.

Although recurrent GERD was determined by upper contrast and milk scan studies, the need for redo surgery in the current study, due to clinically significant recurrent GERD, was less than that documented for radiological recurrent GERD. In concordance with our study, Dunne et al<sup>20</sup> stated in their study, “even though there may be evidence of anatomical failure, the symptomatic outcome following laparoscopic antireflux surgery remains successful.”

## CONCLUSIONS

Bilateral fixation of the wrap to diaphragmatic crura significantly reduced recurrent GERD in laparoscopic Nissen fundoplication for NI children with no increased risk of morbidities. Future prospective studies should be conducted with larger patient populations and longer follow-up periods.

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