

# Nissen Fundoplication for Reflux Esophagitis

## Long-Term Clinical and Endoscopic Results in 109 of 127 Consecutive Patients

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### Objective

This study evaluates the clinical and endoscopic long-term results of Nissen fundoplication in reflux esophagitis.

### Summary Background Data

Nissen fundoplication has been reported to give good results in the treatment of gastroesophageal reflux with success rates up to 78-97%. Most of the previous studies on long-term results of fundoplication have, however, been based on interviews with only sporadic endoscopic examinations.

### Methods

Of 127 patients consecutively treated with Nissen fundoplication for reflux esophagitis, 109 were available for follow-up after a median of 77 months. Upper gastrointestinal endoscopy was done in 105 cases, and all the patients with reflux symptoms or abnormal endoscopic observations were referred to esophageal 24-hour pH monitoring and manometry.

### Results

No symptoms of gastroesophageal reflux were reported by 73 of the 109 patients, but dysphagia was present in 47. Endoscopy showed defective fundic wrap in 24 patients. Objective evidence of reflux was found in 24 patients (endoscopic esophagitis in 18 and pathologic 24-hour pH score without esophagitis in 6). Esophagitis was found in 14 of the 24 patients with defective wrap, but in only 4 of the 81 with intact wrap.

### Conclusions

Nissen fundoplication alleviated symptoms of gastroesophageal reflux and cured esophagitis in great majority of cases. The main determinant of outcome was the state of the fundic wrap.

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Nissen fundoplication<sup>1</sup> can give good results in the treatment of gastroesophageal reflux. Success rates up to

91-97% have been reported,<sup>2-4</sup> with lower figures of 78%<sup>5</sup> and 81%.<sup>6</sup> Disturbing postoperative symptoms have included dysphagia, gas bloat and epigastric pain, sometimes in a substantial number of patients,<sup>6,7</sup> and unsuccessful treatment and severe complications.<sup>8</sup>

Most of the studies on long-term results of fundoplication were based on interviews and included only sporadic endoscopic examinations.<sup>2-6</sup> Reports on systematic postoperative endoscopy or 24-hour pH recordings

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**Table 1. OVERALL CLINICAL RESULTS:  
MODIFIED VISICK (17) GRADING  
(INTERVIEW + ENDOSCOPY  
+ REPEAT FUNDOPLICATION GROUP)**

Visick Grade	No. of Patients	Definition of Modified Visick Grades
1	18 (17%)	No symptoms
2	46 (42%)	Mild, occasional symptoms; no treatment needed
3	39 (36%)	More frequent or severe symptoms, requiring medication or infrequent dilatation
4	6 (5%)	Symptoms not improved or worse than preoperatively and/or reoperation required
Total	109	

are few and have a short follow-up time<sup>9-11</sup> or small number of patients.<sup>12</sup> This study evaluates the clinical and endoscopic long-term results of Nissen fundoplication in reflux esophagitis.

## METHODS

### Patients

In 1981-1987, 189 patients with no prior gastric or esophageal surgery underwent Nissen fundoplication for gastroesophageal reflux at Tampere University Hospital. Esophagitis was endoscopically identified preoperatively in 127 patients. Esophagitis was diagnosed if endoscopy showed Savary-Miller<sup>13</sup> grade 2-4 disease, or if grade 1 lesion was associated with positive histologic evidence of esophagitis<sup>14</sup> or was confirmed by pH recordings. Repeat fundoplication was performed on five (4%) of these 127 patients during the follow-up period. The median age of these 73 men and 54 women was 48 (range 22-74) years at operation. The preoperative duration of reflux symptoms was 1-30 years, and more than 2 years in two-thirds of the patients.

### Operations

Senior surgeons performed or directly supervised the operations. Nissen-Rossetti type anterior wall fundoplication<sup>16</sup> was used, without mobilization of the lesser gastric curvature or ligation of the short gastric vessels. A 32F gastric tube was retained in the esophagus during the plication. Nonabsorbable sutures were used to construct the 3-5 cm long wrap. The wrap was not attached to the esophagus, but instead fixed with the lowermost stitch to the gastric side of the gastroesophageal junction. The plication was fashioned to allow one or two of the operator's fingers to be placed under the plicated wrap. Concomitant operations in the series of 127 fundoplications were cholecystectomy (7 cases), dilatation of esophageal

strictures (8), inguinal herniorrhaphy (6), and breast biopsy (1).

### Follow-up

Of these 127 consecutive patients, 109 were available for reevaluation after a median time of 77 (range 37-110) months. Five of the 109 had undergone repeat operation during the follow-up period (repeat fundoplication group) and four refused endoscopy (interview group). All present endoscopies (endoscopy group, n = 100) and all interviews were made by the author. Clinical and endoscopic data obtained before the five repeat fundoplications were used in analyses. Clinical condition was summarized by modified (Table 1) Visick grading.<sup>17</sup> DeMeester-Johnson criteria<sup>15</sup> were used to calculate clinical reflux score.<sup>18</sup> Special attention was directed to bloating and flatus (Table 2), with the patients assessing the disturbance by any postoperative increase.

Presence of gastric-type epithelium (histologically confirmed) more than 3 cm above the most cranial fold of gastric mucosa was considered to indicate Barrett's esophagus. The state of the fundic wrap was checked at retroflexed endoscopy.<sup>4,10</sup> Slipping was recognized when there was a distinct gastric pouch above the narrowing caused by the folds of the wrap. Disruption of the wrap implied that no folds or only distorted loose folds were visible at the esophagogastric junction. All 52 patients with symptoms suggestive of reflux or abnormal endoscopic findings at follow-up review were referred for 24-hour pH-recording and esophageal manometry,<sup>19</sup> but 8 refused this examination. Three of the five reoperated patients had undergone these function studies before repeat fundoplication. Pathologic reflux was defined as pH < 4 for totally more than 4.2% of the recording time. Manometric evaluation of motility function was performed according to Benjamin et al.<sup>20</sup> Barium examination was made to confirm endoscopic assessment in 25 cases.

### Statistics

Chi-square test or Mann-Whitney U-test was used for unpaired data and Wilcoxon signed-rank sum test and

**Table 2. DISTURBANCE BY INCREASED  
FLATUS AND BLOATING AFTER  
FUNDOPLICATION**

Score	Degree of Disturbance	Flatus + Bloating Scores
0	None	0 = no symptoms
1	Mild	1-2 = mild symptoms
2	Moderate	3-4 = moderate symptoms
3	Severe	5-6 = severe symptoms

**Table 3. SYMPTOMS LEADING TO UNSATISFACTORY VISICK GRADES (3–4) AND THEIR BACKGROUND IN 45 OF 109 PATIENTS**

Symptoms	No. of Cases	Observed Causes	No. of Cases
Dysphagia	2	Esophageal stricture	2
Heartburn & regurgitation	21	Objective reflux*	11
		Paraesophageal hernia	1
		No objective reflux	9†
Epigastric pain	15	Paraesophageal hernia	2
		Disrupted wrap	1
		Gastric ulcer	3
		Duodenal ulcer	3†
		Lactose intolerance	1†
		Celiac disease	1†
		Gastritis	1†
Flatus or bloating	6	Irritable bowel	1†
		Unknown	2
		Paraesophageal hernia	1
		Lactose intolerance	3†
Retrosternal pain	1	Irritable bowel	1†
		Unknown	1
Total	45	DES	1
			45

\* Endoscopic esophagitis and/or total reflux time > 4.2%.  
 † 20 of 45 cases presumably unrelated to reflux disease or surgery.  
 DES = diffuse esophageal spasm.

Spearman rank-correlation test for differences between paired data.

**RESULTS**

**Morbidity**

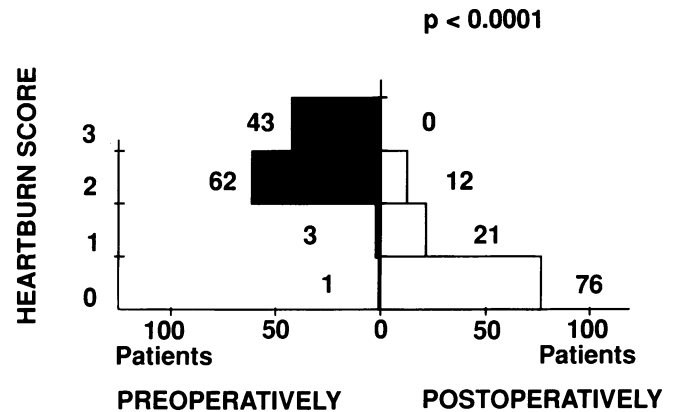
There were no deaths, but 16 (12%) of the 127 patients sustained a total of 25 complications. These included preoperative perforation of the stomach by the 32F nasogastric tube, deep abdominal infection, intestinal obstruction and pneumonia, each in 1 patient, inadvertent splenectomy in 2 patients, wound infection in 5 patients, leading to wound rupture in 2, and incisional hernia in 12 patients, 7 of whom had no other complications.

**Visick Grading**

Excellent or good subjective results (Visick grade 1 or 2) were reported by 64 (59%) of the 109 patients at follow-up evaluation (Table 1). The main reason for unsatisfactory grade was reflux symptoms (Table 3).

**Heartburn, Regurgitation, and Dysphagia**

Heartburn (Fig. 1) and regurgitation (Fig. 2) diminished significantly ( $p < 0.0001$ ) after fundoplication. No

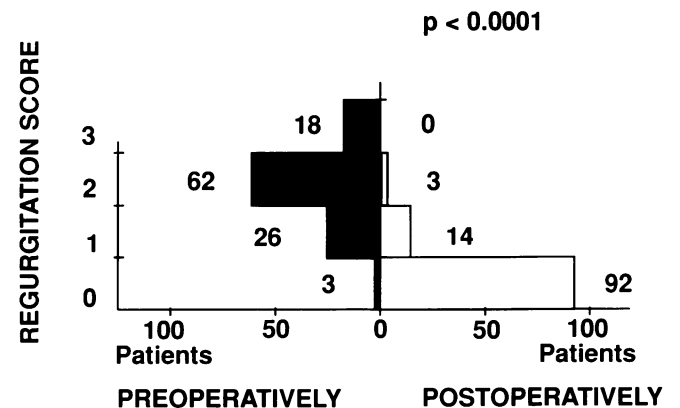


**Figure 1.** Heartburn scores before and after primary fundoplication (interview + endoscopy + repeat fundoplication group, n = 109).

reflux symptoms were reported by 75% of the patients with intact fundic wrap at endoscopy (Table 4). The scores for heartburn and regurgitation decreased in 100 and 104 patients (of 109), respectively, and were unchanged in the others. Only 62 patients were free from dysphagia at follow-up, compared with 83 preoperatively (Fig. 3). Preoperative dysphagia had decreased or disappeared in 19 patients, and was unchanged in 6 patients. Dysphagia increased or began after fundoplication in 36 patients. Forty-six (42%) of the 109 interviewed patients were free from both reflux symptoms and dysphagia at follow-up. Incidence of these symptoms did not differ significantly according to the length of follow-up (Table 5).

**Ability to Belch and Vomit**

At follow-up 19 of the 109 patients reported inability to belch and 44 inability to vomit after fundoplication. Of remainder, 58% and 33%, respectively, described belching and vomiting as more difficult than before.



**Figure 2.** Regurgitation scores before and after primary fundoplication (interview + endoscopy + repeat fundoplication group, n = 109).

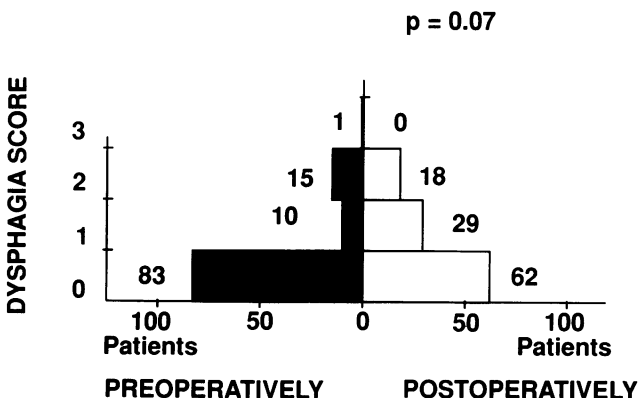
**Table 4. STATE OF FUNDIC WRAP IN RELATION TO VISICK GRADING, DEMEESTER-JOHNSON CLINICAL REFLUX SCORE AND INCIDENCE OF DYSPHAGIA (ENDOSCOPY + REPEAT FUNDOPLICATION GROUP)**

	Fundic Wrap		Total n = 105
	Intact n = 81	Defective* n = 24	
Visick grade†			
1	14 (17%)	3 (12%)	17 (16%)
2	38 (47%)	6 (25%)	44 (42%)
3	28 (35%)	10 (42%)	38 (36%)
4	1 (1%)	5 (21%)	6 (6%)
Clinical reflux score‡			
No	61 (75%)	10 (42%)	71 (67%)
Mild	19 (23%)	9 (37%)	28 (27%)
Moderate	1 (1%)	5 (21%)	6 (6%)
Severe	0	0	0
Dysphagia			
No	45 (56%)	15 (62%)	60 (57%)
Yes§	36 (44%)	9 (38%)	45 (43%)

\* Disrupted or slipped.  
 † p = 0.02.  
 ‡ p = 0.005 for difference between the groups.  
 § DeMeester-Johnson score ≥ 1.

**Flatus and Bloating**

Postoperatively increased flatus was reported by 73 and bloating by 29 of the 109 patients (either/or in 76). These symptoms were severe in only 1 patient and moderately severe in 12 patients. The patients with increased flatus or bloating did not differ from the others as regards incidence of lactose intolerance, irritable bowel or constipation. Those with impaired belching had significantly more often increased flatus than the other patients (79% versus 50% p = 0.0059). At follow-up after more



**Figure 3.** Dysphagia scores before and after primary fundoplication (interview + endoscopy + repeat fundoplication group, n = 109).

**Table 5. CLINICAL FEATURES IN RELATION TO FOLLOW-UP TIME (INTERVIEW + ENDOSCOPY + REPEAT FUNDOPLICATION GROUP, n = 109)**

	Follow-up Time (months)		
	37-59 n = 26	60-83 n = 46	84-110 n = 37
Reflux symptoms	8 (31%)	14 (30%)	14 (38%)
Dysphagia	11 (42%)	25 (52%)	11 (30%)
Belch freely	6 (23%)	16 (35%)	12 (36%)
Increased flatus*	23 (88%)	29 (63%)	21 (57%)
Pathologic 24-hour score†	2 (17%)	6 (29%)	7 (50%)

\* p = 0.02 between the groups with different follow-up time.  
 † pH < 4 for > 4.2% of recording time (% of those tested in the respective groups, from which 46%, 46% and 38% were referred for pH monitoring).

than 5 years (Table 5), significantly fewer patients reported increased flatus (p = 0.02).

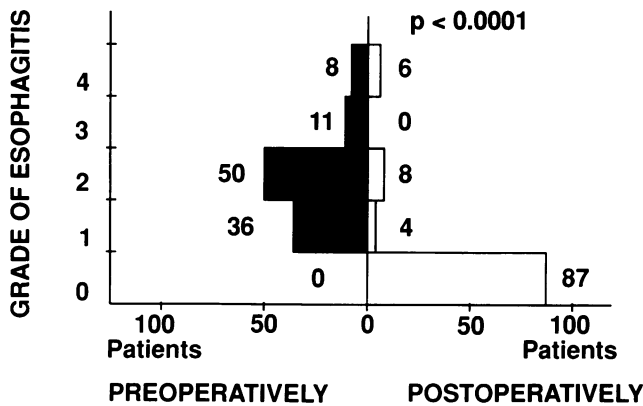
**Fundic Wrap and Esophagitis**

At follow-up endoscopy 24 of 105 fundoplication wraps were defective (Table 6). In all of these 24 patients, there were pathologic results of 24-hour pH measurements and/or at barium examination or endoscopic diagnosis was confirmed at reoperation. The endoscopic esophagitis (Fig. 4) was significantly improved from the preoperative status (p < 0.0001). It was downgraded in 92 patients of the 105, but become worse in 4 patients. Eighteen patients still had esophagitis (Table 7). Barrett's esophagus was observed in 18 patients at follow-up, but in only 6 patients preoperatively. The incidence of defective wrap (Fig. 5) or endoscopic esophagitis (Fig. 6) seemed to increase with duration of follow-up. The mean symptomless time reported by the patients with

**Table 6. STATE OF THE FUNDIC WRAP AND PARAESOPHAGEAL HERNIAS AT FOLLOW-UP ENDOSCOPY**

	Endoscopy Group n = 100	Repeat Fundoplication Group* n = 5	Total n = 105
Patent wrap	81	0	81 (77%)
Defective wrap	19	5	24 (23%)
Disrupted	12	3	15
Slipped	7	2	9
Paraesophageal hernia	3	2	5 (5%)

\* Observations made before, and confirmed at reoperation.



**Figure 4.** Esophagitis grades (Savary-Miller) before and after primary fundoplication (endoscopy + repeat fundoplication group, n = 105).

defective wrap who could pinpoint the onset of recurrence was 44 (0–72) months (Fig. 7).

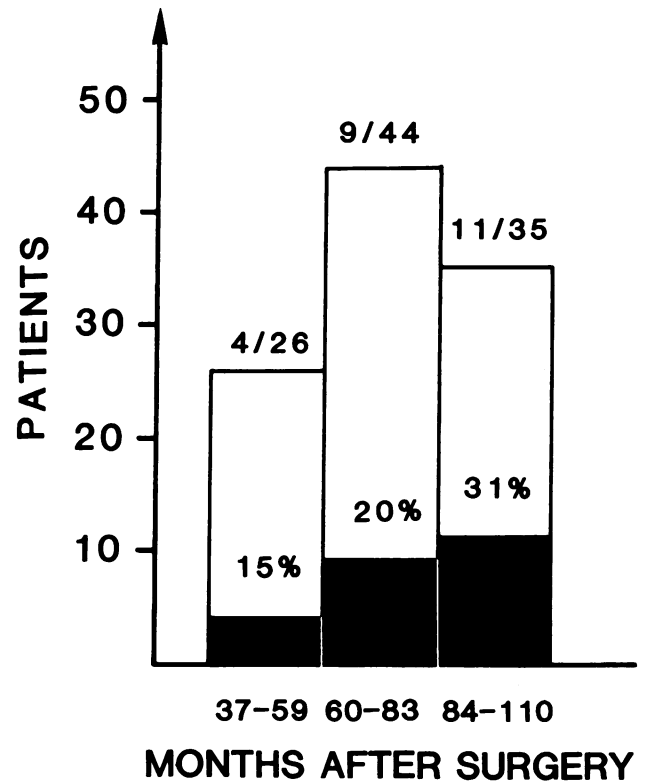
**Gastric Ulcers**

Five uncomplicated gastric ulcers were diagnosed during the observation period of these 109 patients, including three detected at follow-up endoscopy. One ulcer was at the lower border of the fundic wrap and the others were situated more distally. No fistula was found during follow-up.

**Table 7. SAVARY-MILLER ESOPHAGITIS GRADING, BARRETT'S ESOPHAGUS AND 24-HOUR pH SCORE IN RELATION TO STATE OF THE FUNDIC WRAP (ENDOSCOPY + REPEAT FUNDOPLICATION GROUP)**

	Fundic Wrap		
	Intact n = 81	Defective* n = 24	Total n = 105
Endoscopic esophagitis†			
No	77 (95%)	10 (42%)	87 (83%)
Yes	4 (5%)	14 (58%)	18 (17%)
Grade 1	1	3	4
Grade 2	0	8	8
Grade 3	0	0	0
Grade 4	3	3	6§
Barrett's esophagus‡	10 (12%)	8 (35%)	18 (17%)
24-hour pH-score¶			
Normal	25 (93%)	6 (31%)	31 (30%)
Pathologic	2 (7%)	13 (69%)	15 (15%)
Not done	53	5	58 (55%)

\* Disrupted or slipped.  
 † p = 0.0001.  
 ‡ p = 0.03 between the groups.  
 § Four old, two new strictures.  
 ¶ Pathologic = total reflux time (pH < 4) more than 4.2% of the recording time.



**Figure 5.** Defective wraps (no. and %) after primary fundoplication in relation to follow-up time (endoscopy + repeat fundoplication group, n = 105).

**24-Hour pH Recordings**

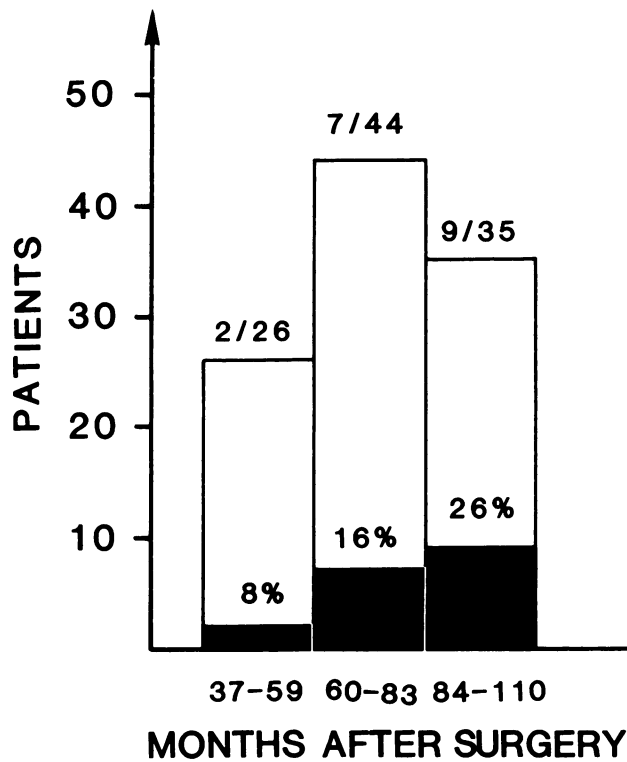
Of the 15 patients with pathologic 24-hour scores (Tables 5, 7), 6 patients did not have esophagitis. The incidence of such pathologic scores seemed to increase with length of postoperative observation (Table 5). Seven of the 17 patients with newly detected Barrett's esophagus had normal values.

**Manometry**

Esophageal motility disorders were observed in 26 patients — diffuse esophageal spasm in one case and non-specific disturbances in the others. The incidence of disturbed motility was not associated with presence or absence of dysphagia.

**Objective Observations in Relation to Symptoms**

Twenty-four hour pH recordings were normal in 17 of 34 patients with symptoms of reflux (Table 8). Patients with defective wrap had more reflux symptoms and lower Visick grades than those with intact wrap (Table 4, p = 0.005 resp. 0.02), but dysphagia was not related to state of the wrap. Increased flatus was more common in the patients with intact wrap (73% vs. 50%), as was inabil-



**Figure 6.** Recurrent endoscopic esophagitis (no. and %) after primary fundoplication in relation to follow-up time (endoscopy + repeat fundoplication group, n = 105).

ity to vomit (65% vs. 40%). Their belching ability was also more often lacking or impaired (67% vs. 57%). These differences were not, however, statistically significant.

**Grade of Preoperative Esophagitis in Relation to Outcome**

The outcome regarding postoperative esophagitis was dependent on the severity of preoperative esophagitis (p = 0.02). At follow-up, the percentages of patients without esophagitis among those with preoperative grades 1-4 were, respectively, 91, 86, 73, and 56. The two new esophageal strictures occurred in preoperative grade 3 cases. The incidence of defective fundic wrap, the Visick symptom grading, clinical reflux and dysphagia scores were similar in all categories of preoperative esophagitis.

**DISCUSSION**

Nissen fundoplication can alleviate symptoms of esophageal reflux and cure esophagitis. Although 63 patients reported symptoms of reflux or dysphagia at follow-up, only 24 had objective signs of reflux, and although esophagitis was seen at 18 of 105 endoscopies and defective fundic wrap at 24, the grade of esophagitis was improved in all 92 patients.

**Mortality and Morbidity**

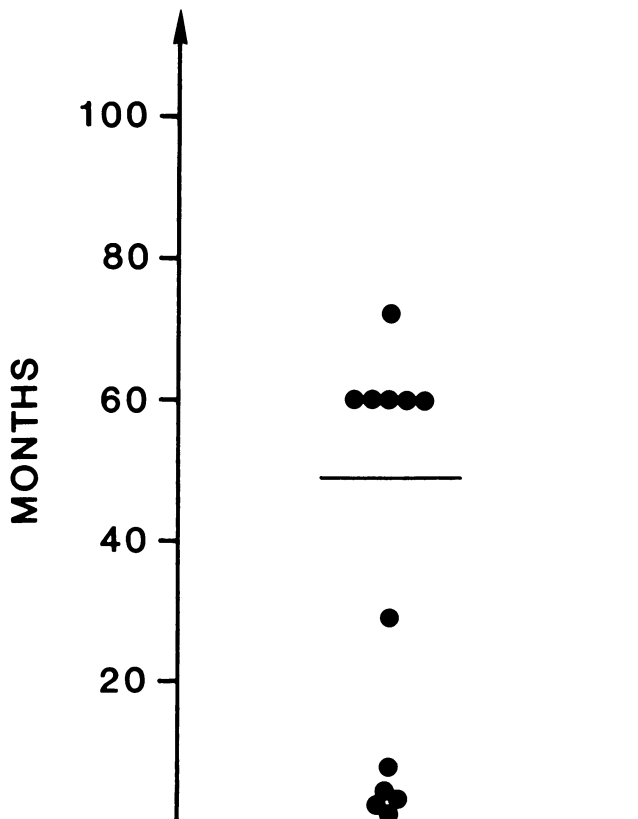
In previous studies<sup>2-4</sup> Nissen fundoplication was associated with mortality rates of 0-1.4%. There were no deaths among the present 127 patients. The 12% morbidity rate was similar to earlier figures.<sup>2-4</sup>

**Visick Grading**

The incidence of Visick symptom grades 1-2 at long-term follow-up was previously reported as 67-85%.<sup>5,6,10,12</sup> In the present series this incidence was 59%, but even occasional use of drugs for symptoms possibly attributable to the operation or suggesting gastroesophageal reflux was recorded as grade 3, as originally proposed by Visick.<sup>17</sup> If the 20 patients for whose symptoms investigations had shown or strongly suggested other explanations (Table 4) are omitted, 77% of all the cases were Visick grade 1 or 2 at follow-up. All patients had esophagitis preoperatively, and thus primarily more severe reflux disease and possibly perhaps also more symptoms than in some earlier series.<sup>5,6,10</sup>

**Reflux Symptoms**

Nissen fundoplication has been shown to abolish reflux symptoms in 91-97% of patients.<sup>2-4</sup> Lower success



**Figure 7.** Onset time of recurrent symptoms: identifiable by 12 patients. Median (44 months) indicated by horizontal line.

**Table 8. SAVARY-MILLER ESOPHAGITIS GRADING AND 24-HOUR pH SCORE IN RELATION TO REFLUX SYMPTOMS (ENDOSCOPY + REPEAT FUNDOPLICATION GROUP, n = 105)**

	Reflux Symptoms	
	Yes,* n = 34	No, n = 71
Fundic wrap†		
Intact	20 (59%)	61 (86%)
Disrupted or slipped	14 (41%)	10 (14%)
Esophagitis‡		
Grade 0	20 (59%)	67 (94%)
Grade 1	4 (12%)	0
Grade 2	6 (17%)	2 (3%)
Grade 4	4 (12%)	2 (3%)
24-hour pH score‡		
Normal	17 (71%)	15 (65%)
Pathologic	7 (29%)	8 (35%)
Unknown	10	48

\* Demeester-Johnson heartburn + regurgitation score  $\geq 1$ .

†  $p = 0.004$  between the groups.

‡ Pathologic = total reflux time (pH < 4) more than 4.2% of the recording time.

rates (c. 80%) were found after 10–20 years of follow-up,<sup>5,6</sup> and in a prospective evaluation only 63% were free from reflux symptoms 2 years postoperatively.<sup>21</sup> These results were similar to these last three reports. Variations in results may be partly due to differences in criteria for symptoms and in methods used to obtain clinical data. All patients in this series were interviewed by me. Most of their postoperative symptoms were mild and occasional, with reduction of subjective heartburn and regurgitation scores in almost all cases and worsening in none. In 71% of the patients with reflux symptoms, the 24-hour pH values were normal, as in previous observations.<sup>21</sup> The incidence of reflux symptoms in these studies with relatively lower success rates was similar to that found in a normal population.<sup>22</sup> Recurrent symptoms tended in this, as in an earlier study,<sup>6</sup> to become more common over the years.

## Dysphagia

In earlier long-term follow-up,<sup>2</sup> 21% of the patients with a long, tight wrap in fundoplication had persistent dysphagia, but when a shorter, more floppy plication was used and the fundus was mobilized that figure decreased to 3%. Other authors reported dysphagia in 38–44% of patients 10–20 years postoperatively.<sup>5,23</sup> Most preoperative dysphagia in these patients disappeared, but 45 patients reported dysphagia at follow-up. That number, however, included mild cases in which the information was elicited only by direct questioning. Most of the pa-

tients had learned to cope by slight changes in swallowing habits. Reported differences in incidence of dysphagia may be partly attributable to the criteria used in assessment, but also to surgical techniques. The original Nissen-Rossetti<sup>16</sup> modification with a long fundic wrap and no mobilization of the fundus was used in the series with the highest incidence of dysphagia.<sup>5,23</sup> Possibly some excessive tightness of the wrap contributed also to the incidence of dysphagia in the present series.

## Belching/Vomiting and Flatus/Bloating

Inability to belch was previously reported in 19–36% of patients with Nissen fundoplication and inability to vomit in 31–63%.<sup>2,23</sup> Of patients with a long, tight fundic wrap, 50% had increased flatus and 21% had symptomatic gas-bloat.<sup>2</sup> The corresponding figures with a short floppy plication were 38% and 15%. The figures in the present study were largely within these ranges. Grading of flatus and bloating is difficult. The method used in the present series was subjective, but provides some estimate of the importance of these symptoms to the patient. Only a minority found them disturbing. Impaired belching ability has logically been suggested to accentuate meteorism.<sup>2</sup> On the other hand, belching is gaseous reflux, with mechanism similar to that of acid reflux,<sup>24,25</sup> so that some restriction of belching ability is inevitably after antireflux surgery. Studies of belching ability by distending the stomach with gas showed reduced belch volume after fundoplication, but no relationship between any abdominal symptoms and results of the belch test.<sup>26</sup> In the present study, however, the patients with reduced belching ability had significantly higher incidence of increased flatus.

## Fate of the Wrap

Previous long-term studies of Nissen fundoplication in adequately large series were based on interviews and included only sporadic endoscopies.<sup>2–6,23</sup> Wrap slippage was found in 25% of patients after 5 years of follow-up, but in a series that included only 12 fundoplications.<sup>12</sup> Figures of 8–9% defective wraps were reported from larger series, but after only short (7–13 months) observation.<sup>10,11</sup> In the present study, 24 of 105 patients were found to have a defective wrap — a considerably higher proportion than in the mentioned short-term studies. The incidence of defects rose with the length of follow-up.

## Esophagitis at Follow-up

Little is known of the long-term course of esophagitis after Nissen fundoplication. Endoscopy 6–7 months postoperatively showed esophagitis in 6–8% of patients,<sup>9,10</sup> but not all of the patients had esophagitis preoperatively. Among patients who all had preoperative

esophagitis, 25% were found to have recurrence 5 years after fundoplication.<sup>12</sup> In the present study, 18 of 105 patients had recurrent esophagitis at follow-up endoscopy, an incidence intermediate between the cited reports.<sup>9,10,12</sup> Endoscopic esophagitis was more common in the patients with longer follow-up.

The increment in incidence of Barrett's esophagus at follow-up was partly only apparent, since some cases presumably were not recognized at preoperative endoscopy. This assumption was supported by the absence of any signs of reflux in some patients with newly noted Barrett's esophagus.

The state of the wrap was the main determinant of outcome with regard to postoperative esophagitis, viz. 5% (4/81) of the patients with intact and 58% (14/24) of these with defective wrap. Similar figures, viz. 1.7% (2/115) and 60% (6/10) were reported earlier.<sup>10</sup> In other words, 78% (14/18) of the cases with esophagitis in the present study had defective wrap.

### Fundoplication and Gastric Ulcer

The occurrence of gastric ulcer after Nissen fundoplication has been reported as 3–9%.<sup>27–29</sup> Gastrobronchial, gastroepiphrenic, and gastroaortic fistulas have been described as arising from penetrating ulcers of the fundoplication wrap,<sup>8</sup> with mechanical factors caused by the wrap suggested to be responsible.<sup>8,28</sup> Recurrent hiatal hernia<sup>28</sup> and primary intrathoracic fundoplication<sup>30</sup> seem to be especially predisposing to ulcer. In the present series, five uncomplicated gastric ulcers were found in 105 patients during the follow-up period, but no fistulas. Only one of the ulcers was at the fundic wrap. Thus, ulcer or fistula formation did not seem to be a major problem in transabdominal fundoplication. That the fundic wrap was not sutured to the esophagus may have helped to prevent fistula.

### 24-Hour pH Recording

Pathologic reflux was previously found in 9.6% of 125 patients with short-term observation<sup>10</sup> after fundoplication and in 11% of 27 after 2 years.<sup>21</sup> In the present study all patients with heartburn, regurgitation, or abnormal endoscopic findings were referred for 24-hour pH monitoring. As only a few declined the examination, it presumably comprised most of those with recurrent reflux. The 15 pathologic scores in 105 patients were slightly more than in previous reports with shorter follow-up. The incidence of pathologic score increased with length of follow-up. Together with the time-related increase of wrap complications and esophagitis, these observations seem to reflect effects of slow wear and tear. Only two of the 15 pathologic scores were in patients with intact wrap. Similar association between pathologic reflux and state of the fundic wrap was previously demonstrated.<sup>10</sup>

### Objective Observations in Relation to Symptoms

As in the present study, discrepancies between subjective and objective results were previously found after Nissen fundoplication.<sup>10,21</sup> Unreliability of symptoms for predicting objective findings was observed also in nonsurgically treated gastroesophageal reflux.<sup>31</sup> By and large, however, symptoms were more common when some abnormality was objectively demonstrable.

### Do Postoperative Symptoms and Objective Recurrences Restrict Surgical Success?

Although many patients in this study reported some symptoms postoperatively, almost all were satisfied with the results of operation regarding diminution of disabling heartburn or regurgitation. Apart from the five who required repeat fundoplication, only the patient with diffuse esophageal spasm was dissatisfied with the primary operation. Despite objective evidence of reflux in 24 cases, the degree of endoscopic esophagitis was improved postoperatively in 92 of the 105 patients and was worse in only 4 patients. Wrap complications were not inevitably associated with other objective abnormality or symptoms, although disruption or slippage of the wrap was observed in almost every case of recurrence.

Attempts have been made to create a more durable wrap by promoting adherence between the two layers of the fundic wrap with electrocoagulation,<sup>32</sup> or by using Teflon® pledgets<sup>2</sup> to prevent cutting through by the sutures. These measures were not used in the present series, but nonabsorbable sutures were used and the wrap was always anchored by the lowest fundic suture to the gastric side of the gastroesophageal junction.

This study showed a relationship between preoperative and postoperative severity of esophagitis. Earlier authors<sup>33,34</sup> observed progressive deterioration of esophageal motility with increase of esophagitis-induced injury, possibly requiring resection. These observations, and the prevailing relative mildness of symptoms after Nissen fundoplication, indicate the advisability of such anti-reflux measures without undue delay when esophagitis is not reasonably improved by conservative management.

### Follow-up

Although a main goal of fundoplication is freedom from symptoms, prompt detection of possible failure to prevent and treat complications is also important. Long (though not particularly frequent) endoscopic follow-up is necessary, since failure may be late in appearing. Presence or absence of symptoms is not a reliable guide to the objective status of the esophagus after surgery for reflux.



## CONCLUSIONS

Nissen fundoplication gives good subjective and objective long-term results in the treatment of reflux esophagitis, but postoperative follow-up must continue for years. Side effects and drawbacks of the operation present a challenge for future work. Dysphagia, disturbed belching and vomiting, and increased flatus and bloating may in future be reduced by the use of a floppy, short and fundusmobilizing technique in fundoplication, though objective proof is not yet available. A greater problem is how to achieve a more durable fundic wrap.

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