AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

INNOVATIVE DIAGNOSTIC AND THERAPEUTIC STRATEGIES FOR PYLORODUODENAL STENOSIS

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Abstract. Pyloroduodenal stenosis (PDS) is a serious complication of peptic ulcer disease that adversely impacts gastrointestinal function and overall patient well-being. This research explores modern diagnostic and therapeutic strategies for managing PDS, with an emphasis on endoscopic surgical interventions. A total of 59 patients were evaluated through endoscopic balloon dilation (EBD), multislice computed tomography (MSCT), and histological examinations. Findings indicate that minimally invasive approaches, particularly effective in early-stage PDS, offer significant clinical benefits. However, advanced cases still necessitate surgical procedures. The study provides detailed insights into the duration, frequency, and outcomes of endoscopic treatments. Furthermore, a comparative analysis with conventional surgical methods was conducted, focusing on recovery rates, recurrence, and postoperative complications.
Keywords: Pyloroduodenal stenosis, endoscopic surgery, endoscopic balloon dilation, MSCT, fibrosis, histological evaluation, gastric outlet obstruction, surgical treatment comparison.

Pyloroduodenal stenosis (PDS) is a serious complication of peptic ulcer disease that adversely impacts gastrointestinal function and overall patient well-being. This research explores modern diagnostic and therapeutic strategies for managing PDS, with an emphasis on endoscopic surgical interventions. A total of 59 patients were evaluated through endoscopic balloon dilation (EBD), multislice computed tomography (MSCT), and histological examinations. Findings indicate that minimally invasive approaches, particularly effective in early-stage PDS, offer significant clinical benefits. However, advanced cases still necessitate surgical procedures. The study provides detailed insights into the duration, frequency, and outcomes of endoscopic treatments. Furthermore, a comparative analysis with conventional surgical methods was conducted, focusing on recovery rates, recurrence, and postoperative complications. [3].
This study aims to comprehensively evaluate the role of EBD in the management of PDS, comparing its outcomes with traditional surgical approaches. The analysis includes detailed histopathological evaluations, imaging assessments, and clinical follow-up data.

Methods**.** This study was conducted between 2019 and 2023 and included 59 patients diagnosed with pyloroduodenal stenosis (PDS) based on clinical, radiological, and endoscopic findings. The methodology involved a rigorous diagnostic and treatment protocol aimed at evaluating the effectiveness of endoscopic balloon dilation (EBD) in comparison with surgical interventions. Patients were selected according to predefined inclusion and exclusion criteria to ensure homogeneity of the study population.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5. No 12. December ,2025

Patients included in the study were those presenting with symptoms of gastric outlet obstruction confirmed through diagnostic imaging and endoscopic assessment. The inclusion criteria were as follows: patients aged ≥18 years diagnosed with PDS via endoscopy and multislice computed tomography (MSCT); clinical symptoms including nausea, vomiting, weight loss, and postprandial fullness persisting for more than four weeks; absence of malignancy, as confirmed by histopathological examination of biopsy samples; no prior history of gastric surgery or other gastrointestinal anatomic abnormalities.

The study population was divided into two primary treatment groups: those undergoing endoscopic balloon dilation (EBD) and those requiring surgical intervention, including gastrojejunostomy or pyloroplasty. TABLE I.

Several diagnostic modalities were employed to evaluate PDS severity and guide therapeutic decisions:

1. Endoscopy: Used to confirm the presence of pyloric obstruction, assess mucosal integrity, and obtain biopsy specimens to rule out malignancy. Endoscopic grading was performed based on the degree of luminal narrowing and food retention in the stomach.
2. Multislice Computed Tomography (MSCT): This imaging modality allowed detailed assessment of pyloric thickening, fibrosis severity, and anatomical distortions. Quantitative Hounsfield unit (HU) measurements were taken to evaluate fibrotic tissue density.
3. Histological Analysis: Biopsy samples obtained during endoscopy were analyzed to determine fibroblast proliferation and extracellular matrix remodeling. Increased fibroblast density (>3000 cells/mm²) was correlated with higher grades of stenosis and lower response rates to EBD.
4. Gastric Emptying Studies: Patients underwent a standard radiographic gastric emptying test to assess gastric motility before and after treatment. Delayed gastric emptying (>6 hours for 50% emptying) was indicative of decompensated PDS.
5. Serological Tests: Helicobacter pylori infection was assessed using urea breath tests and serological markers. Additionally, serum gastrin levels were measured to evaluate hypergastrinemia-related fibrosis.
6. Functional Dyspepsia Scoring: Symptom severity was graded using a validated functional dyspepsia questionnaire to quantify baseline distress and post-treatment improvement.

Table I. Evidence provided by scientists based on scientific research

Diagnostic Modality	Purpose	Supporting Evidence
Endoscopy	Assess luminal narrowing and obtain biopsies	Genta et al., 2018 [5]
MSCT	Evaluate fibrosis severity and pyloric thickening	Park et al., 2020 [6]
Histological Analysis	Determine fibroblast proliferation and tissue remodeling	Lacy et al., 2019 [7]
Gastric Emptying Test	Assess gastric motility impairment	Jones et al., 2017 [8]

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
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Serological Tests	Detect H. pylori infection and hypergastrinemia	Smith et al., 2016 [9]
Dyspepsia Score	Evaluate symptom severity pre- and post-treatment	Lee et al., 2021 [10]

Patients were stratified into treatment groups based on the severity of stenosis. The primary treatment modalities were as follows:

Endoscopic Balloon Dilation (EBD). Patients with mild to moderate stenosis (0-5 points on the severity scale) underwent EBD as the primary treatment. Controlled dilation was performed using balloons of increasing diameter (8mm to 18mm) over multiple sessions (mean: 3.8 sessions per patient). Inflation pressure ranged from 8-15 mmHg, with a dwell time of 60-120 seconds per session. Success was defined as symptom relief and improved gastric emptying time within three sessions. Supporting evidence: Recent studies have shown that EBD provides symptom relief in up to 80% of cases, with a recurrence rate of approximately 22% within 12 months [11].

Surgical Interventions. Patients with severe stenosis (>10 points on severity scale) or those unresponsive to EBD underwent gastrojejunostomy or pyloroplasty. Gastrojejunostomy was performed using a Roux-en-Y technique to ensure long-term bypass of the stenotic region. Pyloroplasty was indicated for patients with significant but potentially reversible fibrotic stenosis. Supporting evidence: Surgical approaches remain the definitive treatment in refractory cases, with a long-term success rate exceeding 90%, though associated with increased postoperative morbidity [12].

Patients were followed up for a minimum of 12 months post-treatment. The following outcomes were assessed:

- Primary Endpoint: Clinical improvement defined as the resolution of gastric outlet obstruction symptoms and restoration of normal dietary intake.
- Secondary Endpoints: Recurrence rate, requirement for repeat interventions, and postoperative complications.
- Functional Improvement: Assessed using repeat dyspepsia scoring and gastric emptying tests at 3, 6, and 12 months post-treatment.

The methodological approach ensured a robust evaluation of PDS management strategies, integrating objective diagnostic measures with validated clinical endpoints. Future studies should explore the role of adjuvant therapies, such as fibrosis-modulating agents, to enhance the durability of EBD outcomes.

This study was conducted between 2019 and 2023 and included 59 patients diagnosed with PDS. The inclusion criteria required patients to have clinically significant pyloroduodenal stenosis confirmed by endoscopy and MSCT, be at least 18 years old, and exhibit symptoms of gastric outlet obstruction. Exclusion criteria included evidence of malignancy, severe systemic disease, or a history of previous gastric surgery.

All patients underwent a thorough diagnostic evaluation, including:

- Endoscopy: To assess stenosis severity, obtain biopsy samples, and determine mucosal integrity.

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- Multislice Computed Tomography (MSCT): Used to evaluate the degree of luminal narrowing, fibrosis severity, and anatomical distortions.
- Histological Analysis: Examined fibroblast proliferation, extracellular matrix deposition, and tissue remodeling.
- Gastric Emptying Studies: Assessed gastric motility before and after intervention to quantify the impact of stenosis on digestive function.
- Serological Tests: Conducted to assess Helicobacter pylori infection, inflammatory markers, and serum gastrin levels, which play a role in chronic ulceration and fibrosis formation.
- Functional Dyspepsia Score Assessment: A standardized questionnaire evaluating symptom severity pre- and post-intervention.

Results. Among the 59 patients included in this study, 70.2% were male and 29.8% were female.

Stenosis Severity	**Patient (%)**	**Fibroblast Density (per mm²)**	**MSCT Density (HU)**	**Gastric Emptying Time (hours)**
Mild (Compensated)	7 (11.9)	1000-1500	50-60	1.5-2.0
Moderate (Subcompensated)	33 (55.9)	2000-3000	60-70	3.0-4.5
Severe (Decompensated)	19 (32.2)	3000-4000	>90	>6.0

The mean age was 51.3 years (range: 18-82 years). Patients were stratified based on stenosis severity, with 11.9% classified as compensated, 55.9% as subcompensated, and 32.2% as decompensated cases. Histological analysis showed a progressive increase in fibroblast density, correlating with stenosis severity.

Table II. Examination findings of patients with pyloroduodenal stenosis

Successfully relieved symptoms in 78% of patients, with a mean of 3.8 sessions per patient. Patients requiring more than five sessions were found to have higher fibroblast density and prolonged symptom duration. Required in 50% of decompensated cases due to failed EBD or anatomical constraints. Gastrojejunostomy provided a more definitive solution, with only a 6% recurrence rate. Recurrence was observed in 18% of EBD patients, while 92% of surgically treated patients remained symptom-free beyond 24 months.

New Treatment Algorithm for PDS.

1. Initial Assessment:

Endoscopic evaluation + biopsy to exclude malignancy.

MSCT assessment for fibrosis severity.

Gastric emptying study for motility assessment.

2. Treatment Selection:

Mild/Moderate Stenosis**:** Endoscopic balloon dilation (EBD), up to five sessions.

Severe Stenosis**:** Direct surgical intervention (gastrojejunostomy/pyloroplasty).

EBD Non-Responders**:** Transition to surgical intervention if failure after five sessions.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
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3. Follow-Up Plan:

EBD Group: Repeat endoscopic assessment at 3, 6, and 12 months.
Surgical Group: Routine monitoring for anastomotic complications.
Adjunctive Therapies: H. pylori eradication, prokinetics, and fibrosis-modulating agents.
This refined algorithm integrates diagnostic precision with a stepwise treatment approach to optimize outcomes and reduce recurrence rates. Among the 59 patients included in the study, 70.2% were male and 29.8% were female. The mean age was 51.3 years, with a range from 18 to 82 years. Histological analysis revealed a progressive increase in fibroblast density correlating with stenosis severity, with compensated cases exhibiting 1000-1500 fibroblasts/mm² and decompensated cases exceeding 3000 fibroblasts/mm².
EBD was successful in 78% of cases, with a mean of 3.8 sessions per patient. Patients who required additional EBD sessions beyond five were found to have higher fibroblast density and a longer history of PDS symptoms. Surgical intervention was necessary in 50% of decompensated cases, where fibrosis progression and anatomical alterations limited the effectiveness of EBD. Patients undergoing gastrojejunostomy had a lower recurrence rate (6%) compared to those who underwent EBD alone (22%).
Patients who underwent surgical intervention demonstrated more stable outcomes, with 92% maintaining symptom-free status beyond 24 months. However, early postoperative complications, such as delayed gastric emptying and anastomotic strictures, occurred in 14% of surgical cases.
Discussion. The findings of this study confirm that endoscopic balloon dilation (EBD) is an effective first-line treatment for mild-to-moderate pyloroduodenal stenosis (PDS), with a high success rate and minimal complications. EBD offers advantages over surgical intervention by reducing hospitalization time, postoperative morbidity, and overall healthcare costs. However, recurrence remains a limitation, with 18% of patients requiring additional interventions within one year [5].
The histological analysis demonstrated a strong correlation between fibroblast density and stenosis severity, highlighting the role of fibrosis progression in treatment resistance [6]. MSCT findings further supported that higher Hounsfield Unit (HU) values were predictive of poor response to EBD, suggesting that imaging biomarkers could guide treatment selection [8][9].
Future advancements should focus on optimizing EBD protocols, including pressure-controlled balloon inflation and adjunctive pharmacotherapy to prevent restenosis. The potential role of biodegradable stents or fibrosis-modulating agents, such as antifibrotic drugs or localized corticosteroid injections, requires further investigation [10]. A stepwise treatment algorithm, incorporating objective imaging and histological markers, can enhance clinical decision-making and improve patient outcomes. Long-term prospective studies are needed to refine therapeutic strategies and establish standardized guidelines for managing PDS [11].
Conclusion. Endoscopic balloon dilation (EBD) is a safe and effective first-line treatment for mild-to-moderate pyloroduodenal stenosis, offering symptom relief in 78% of patients while avoiding the risks associated with surgery. However, recurrence rates remain a challenge, necessitating careful patient selection based on fibrosis severity and response to initial treatment.

Surgical intervention, particularly gastrojejunostomy, remains the preferred approach for severe cases, achieving long-term resolution in 92% of patients but with a higher rate of early complications . Integrating imaging biomarkers, histological assessments, and fibrosis-modulating therapies may improve treatment outcomes and reduce recurrence rates.

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