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Research Article

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Posted Date: October 7th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11034010/v1>

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Additional Declarations: No competing interests reported.

Evaluation of the efficacy and safety of modified endoscopic submucosal dissection in the treatment of gastric stromal tumors

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Abstract

Objective: This study aimed to systematically evaluate the clinical efficacy and safety of the modified endoscopic submucosal dissection (ESD) in the treatment of gastric stromal tumors.

Methods: A retrospective study was conducted on the clinical data of 80 patients with small gastric stromal tumors admitted to the Department of Gastroenterology of Anqing First People's Hospital from July 2020 to October 2024. The patients were divided into a control group and an observation group. Forty patients in the control group were treated with traditional ESD, while 40 patients in the observation group were treated with ESD assisted by a ligator with dental floss. The general information of the two groups (including age, gender, tumor origin site, and tumor size), the complete tumor resection rate (R0 resection rate), operation time, length of hospital stay, hospitalization expenses, incidence of complications, and recurrence rate were analyzed.

Results: There were no significant differences in age, gender, tumor location, tumor size, etc. between the two groups ($P>0.05$). All patients in

both groups completed ESD resection, and the complete resection rate was 100%. The operation time in the control group was (111.43 ± 57.03) min, while that in the observation group was (49.35 ± 23.38) min. The operation time in the observation group was significantly shorter than that in the control group, and the difference was statistically significant ($P < 0.05$). The hospitalization expenses in the control group were (21984.21 ± 5557.63) yuan, while those in the observation group were (19505.74 ± 4702.22) yuan. The hospitalization expenses in the observation group were significantly less than those in the control group, and the difference was statistically significant ($P < 0.05$). There were 4 cases of complications in the control group, while there were no complications in the observation group, and the difference was statistically significant ($P < 0.05$). No tumor recurrence was found in either group during the follow - up at 6 months, 12 months, and 24 months.

Conclusion: The modified ESD is effective and safe in the treatment of gastric stromal tumors and can completely resect the lesions. This study not only focuses on the short - term effects of technical improvement but also provides a standardized reference for the minimally invasive treatment of gastric stromal tumors through multi - dimensional evaluation of efficacy and safety, promoting the precise application of minimally invasive techniques.

Keywords: Gastric stromal tumor; Modified endoscopic submucosal

dissection; Efficacy; Safety

Gastric stromal tumor (GIST) is the most common gastrointestinal mesenchymal tumor, with an annual incidence of approximately 1/100,000 to 1.6/100,000. Studies have shown that tumorigenesis originates from interstitial cells of Cajal (ICC) in the gastrointestinal tract, which are responsible for triggering gastrointestinal activities. Gastrointestinal stromal tumors occur in the digestive tract, including the stomach (60% - 70%), small intestine (20% - 25%), colon and rectum (5%), and esophagus (<5%), among which GIST is the most common ^[1]. Surgical resection is the main treatment for GIST. Traditional open surgery and laparoscopic surgery are associated with large trauma, significant patient suffering, and high costs. In recent years, with the development of endoscopic resection techniques, they have been widely used in the diagnosis and treatment of gastric submucosal tumors ^[2]. Compared with traditional surgical procedures, endoscopic resection has advantages such as definite efficacy, high safety, minimal trauma, and rapid recovery ^[3]. Endoscopic submucosal dissection (ESD) is widely used in Asia for the resection of early gastrointestinal cancers and submucosal tumors. ESD is considered to be able to cure patients with early gastrointestinal cancers. However, it is a technically challenging procedure that can be time - consuming and is associated with complications such as bleeding and perforation. Traction devices and

techniques have been developed to mitigate these risks and shorten the operation time ^[4]. To find a better endoscopic treatment method, we used a modified ESD to treat small GISTs and achieved good treatment outcomes. The details are reported as follows:

1. Materials and Methods

1.1 General informationA retrospective study was conducted on 80 patients with small gastric stromal tumors (diameter ≤ 2 cm) treated with endoscopic submucosal dissection (ESD) in the Department of Gastroenterology of Anqing First People's Hospital from July 2020 to October 2024. According to different surgical methods, the patients were divided into a control group (using the traditional ESD method) and an observation group (performing ESD with a new traction - assisted device of a ligator with dental floss), with 40 cases in each group. Inclusion criteria: 1. The diameter of the tumor lesion was ≤ 2 cm, with small tumor volume and slow growth, and imaging suggested low/very low risk. 2. Endoscopic ultrasonography showed that the tumor was located in the muscularis propria and was not adherent to the serosa. 3. The patients strongly requested to preserve gastric function or refused open surgery. 4. The tumor had clear boundaries and could be completely dissected endoscopically; CT or MRI examination showed no invasion of adjacent organs. Exclusion criteria: 1. The diameter was > 2 cm or the tumor invaded the serosa; 2. There was lymph node or distant metastasis (such

as liver and peritoneal metastasis); 3. The tumor was adherent to large perigastric blood vessels (such as branches of the left gastric artery). 4. Coagulation dysfunction (INR > 1.5 or platelets < 50×10⁹/L); 5. Severe cardiopulmonary diseases (such as recent myocardial infarction, severe COPD) that were not suitable for gastroscopy. 6. Pregnant or lactating women; uncontrolled systemic infection or sepsis. Patients signed the informed consent form for the selection of endoscopic minimally - invasive surgical methods. This study was approved by the Medical Ethics Committee of Anqing First People's Hospital.

1.2 Instruments and Equipment

Olympus CV-290 Electronic Gastrointestinal Endoscopy System, Olympus Corporation (Japan)

Olympus GIF 260J, Olympus Corporation (Japan)

Endoscopic ultrasound, EU-ME2 Premier Plus, Olympus Corporation (Japan)

Single-use endoscopic injection needle, SD-04-A2323-4, Zhejiang Shouding Medical Technology Co., Ltd.(China)

Single-use endoscopic ligator, GL-EL-6, Jiangsu Greete Medical Technology Co., Ltd.(China)

Dental floss, 50m, Zhangjiagang Juying Trading Co., Ltd.(China)

Disposable mucosal incision knife, MD-O-ES244016, Zhejiang Chuangxiang Medical Technology Co., Ltd.(China)

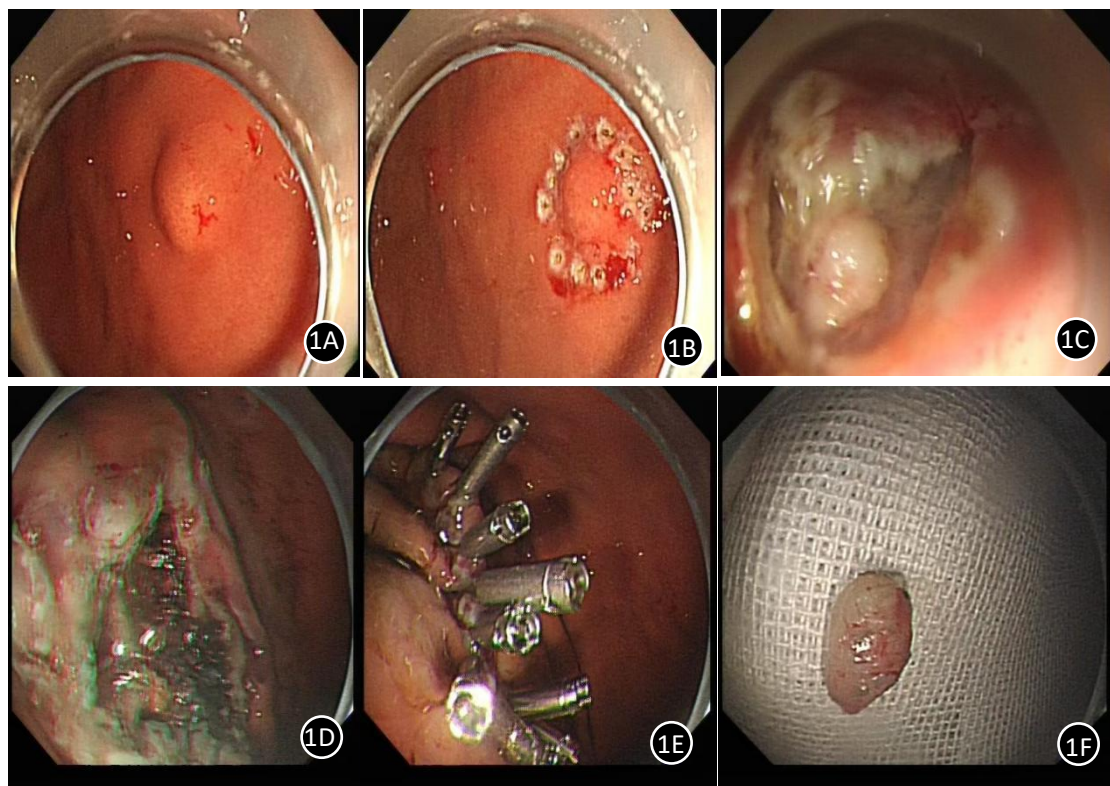
High-frequency electrosurgical system, ERBE VO 300D (Germany)

Single-use high-frequency hemostatic forceps, CF195-AT, Nanwei Medical Technology Co., Ltd.(China)

Clip device, SD-02-230-9C, Zhejiang Shouding Medical Technology Co., Ltd.(China)

1.3 Methods

1.3.1 Endoscopic surgical method used in the control group Marking at the lesion site, submucosal injection at the lesion site, circumferential incision at the lesion site, dissection of the lesion, specimen retrieval, wound surface treatment, and sending the lesion for pathological examination. (Figure 1)



1A: Gastric stromal tumor lesion under gastroscopy;

1B: Marking the lesion and performing submucosal injection;

1C: Circular incision at the lesion;

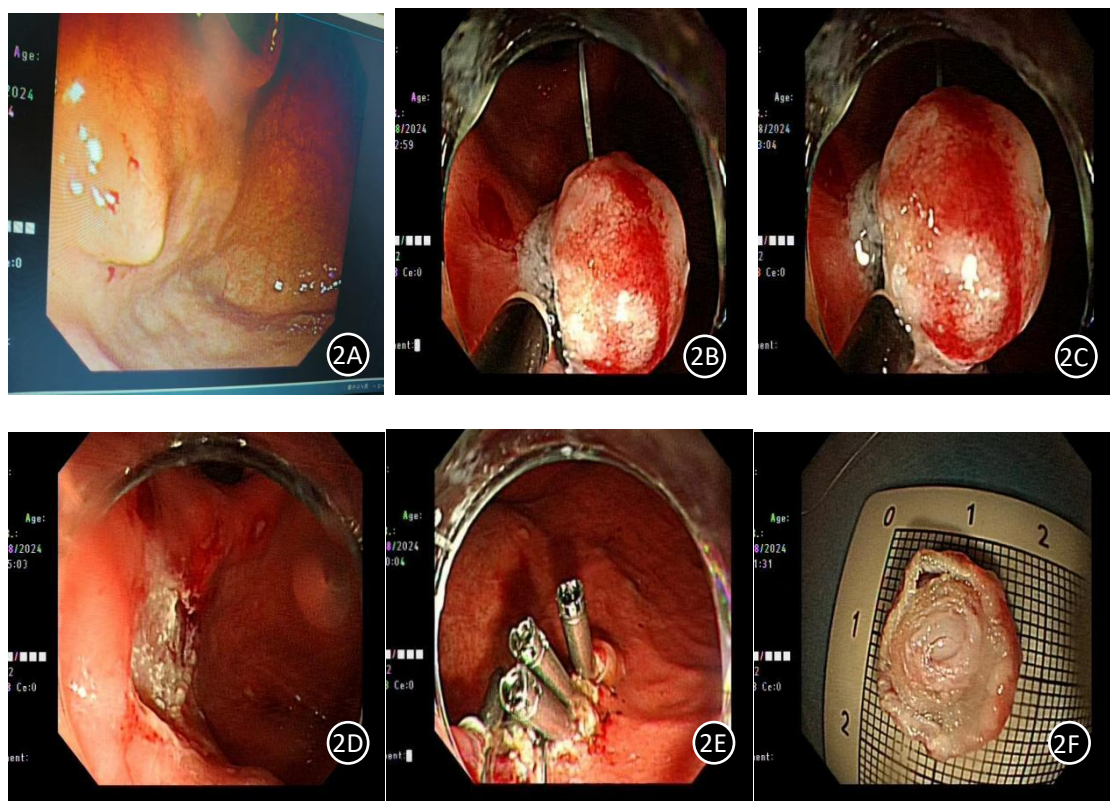
1D: Wound surface after lesion dissection;

1E: Closing the wound surface with titanium clips;

1F: Retrieving the specimen and sending it for pathological examination.

Figure 1 Resection of gastric stromal tumors by traditional endoscopic submucosal dissection

1.3.2 Endoscopic surgical method used in the observation group Mark the lesion. Use a ligator with dental floss to ligate the lesion. Dissect the lesion along the ligation base. Retrieve the specimen. Treat the wound surface. Send the lesion for pathological examination. If the size of the lesion exceeds 1.2 cm, perform fractional ligation. (Figure 2)



2A: Gastric stromal tumor lesion under gastroscopy;

2B: The lesion was ligated with a ligator with dental floss;

2C: The lesion was dissected along the ligation base;

2D: The wound surface after lesion dissection;

2E: The wound surface was closed with titanium clips;

2F: The specimen was retrieved and sent for pathological examination.

Figure 2. ESD-assisted resection of gastric stromal tumors using a ligator with dental floss

1.4 Determination of pathological results Tumor risk stratification: The risk of GIST was stratified according to the risk stratification criteria for primary GIST recommended in the "Pathological Interpretation of the Chinese Expert Consensus on the Diagnosis and Treatment of Gastrointestinal Stromal Tumors (2017 Edition)". The pathological grades of the selected 80 cases of gastric stromal tumors were all very low risk. (Figure 3)

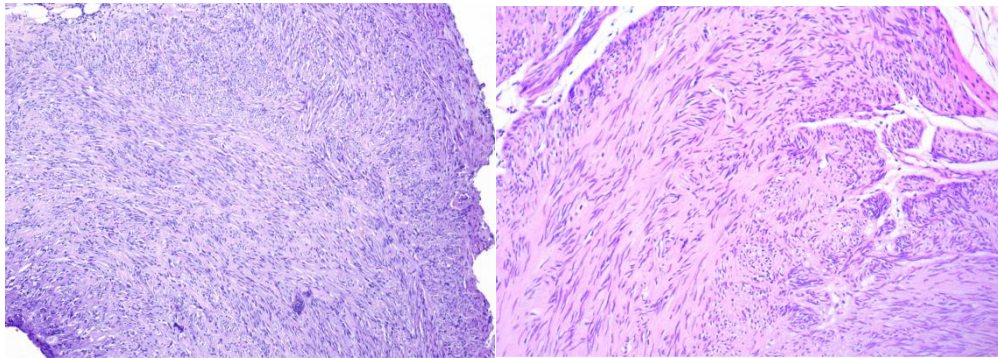


Figure 3. Pathology of gastric stromal tumor indicates very low risk.

1.5 Postoperative management The two groups received the same postoperative treatment. All patients were hospitalized for observation for 3 - 7 days. They were kept on fasting for 3 days after the operation and were required to stay in bed. Symptomatic treatments such as acid suppression and anti - infection were given. Complications such as bleeding, perforation, and infection were monitored. On the 4th day after the operation, patients started to have liquid diet, and on the 5th day, they switched to semi - liquid diet. Normal diet was resumed 2 weeks later.

Follow - up was conducted at 3 and 6 months after the operation, and gastroscopy was re - examined.

1.6 Evaluation indicators Complete resection rate (R0 resection rate):

Under direct endoscopic visualization, if the tumor is judged to be resected in one attempt, with no residual tumor tissue, the specimen is removed in one piece, and the tumor mass is intact, then the tumor is considered to be completely resected endoscopically; at the pathological level, both the deep and lateral resection margins are negative. Surgical

time: The time from the marking of the lesion margin with a disposable mucosal knife to the completion of the suture of the lesion

wound. Postoperative complications: including postoperative bleeding, perforation, infection, etc., are evaluated using the following indicators: (1)

Postoperative bleeding refers to the occurrence of hematemesis or vomiting coffee-ground-like substances, melena or bloody stools, and manifestations of circulatory instability (early signs of shock, dynamic decrease in hemoglobin, etc.) within 1 week after surgery. (2)

Postoperative perforation refers to observing whether the patient experiences abdominal pain, abdominal distension, and peritoneal irritation signs after surgery. X-ray examination shows free gas under the diaphragm in the upright abdominal plain film. (3) The exacerbation of postoperative infection refers to the occurrence of elevated body temperature, ineffectiveness of the originally used antibiotics, and

intensified abdominal pain, etc. Compare the surgical success rate, operation time, en bloc resection rate of lesions, postoperative complications, hospitalization costs, length of hospital stay, and the recurrence status of tumors during the follow - up at 6 months, 12 months, and 24 months between the two groups of patients.

1.7 Statistical analysis methods Statistical analysis was performed using SPSS 27.0 software. The independent two-sample t-test was used for comparison between groups, the rank-sum test was adopted for non-parametric tests, and the χ^2 test was used for comparison between groups of count data. A P-value < 0.05 was considered statistically significant.

Results

2.1 Comparison of baseline data between the two groups According to the inclusion and exclusion criteria, a total of 80 patients were enrolled, including 40 in the control group, with 13 males and 27 females, aged 44 - 74 (59.03 ± 8.52) years; and 40 in the observation group, with 12 males and 28 females, aged 45 - 73 (59.05 ± 6.4) years. The tumor size (based on the size of the mass sent for pathological examination) was 0.5 - 2.0 (1.01 ± 0.42) cm in the control group and 0.5 - 1.6 (1.05 ± 0.33) cm in the observation group. There were no statistically significant differences between the two groups in terms of age, gender, tumor location, tumor size, etc. ($P > 0.05$). See Table 1.

Table 1 Comparison of basic data between the two groups

item		observation group	control group	t/x ²	P value
n		40	40		
sex	male	12	13	0.06	0.81
	female	28	27		
Site of tumor	fundus ventriculi	31	29	0.27	0.61
	corpora ventriculi	9	11		
age		59.05±6.41	59.03±8.52	0.38	0.70
Tumor diameter		1.05±0.33	1.01±0.42	1.06	0.29

2.2 Comparison of efficacy evaluation indicators between the two groups

A total of 80 patients in the two groups successfully completed the ESD resection, with a complete resection rate of 100%. The operation time in the control group was (111.43±57.03) min, and that in the observation group was (49.35±23.38) min. The operation time in the observation group was significantly shorter than that in the control group, and the difference was statistically significant (P<0.05). The hospitalization cost in the control group was (21984.21±5557.63) yuan, and that in the observation group was (19505.74±4702.22) yuan. The hospitalization cost in the observation group was significantly less than that in the control group, and the difference was statistically significant

($P<0.05$). In the control group, 1 case had delayed bleeding after surgery, 2 cases had postoperative perforation, and 1 case had postoperative infection. All of them improved and were discharged from the hospital after treatment during the hospitalization. No complications occurred in the observation group, and the difference was statistically significant ($P<0.05$). There was no statistically significant difference in the length of hospital stay between the two groups ($P>0.05$). No tumor recurrence was observed in the two groups during the follow - up at 6 months, 12 months, 24 months, and 36 months. See Table 2.

Table 2 Comparison of efficacy evaluation indicators between the two groups

item	observation group	control group	t/x ²	P value
surgery time	49.35±23.38	111.43±57.03	5.61	0.000
Hospital costs	19505.74±4702.22	21984.21±5557.63	2.15	0.03
complication	0	4	4.21	0.04
length of stay	7.85±1.27	8.65±2.66	0.71	0.48
Tumor resection rate (R0)	100%	100%	0.000	1.00

3.Discussion

Gastrointestinal stromal tumor (GIST) originates from the interstitial cells of Cajal (ICC) in the gastrointestinal myenteric plexus and is the most common mesenchymal tumor of the gastrointestinal tract ^[5]. It is mostly caused by oncogenic activating mutations in the KIT or PDGFRA

genes. The global incidence is approximately 10 - 20 per million, mainly affecting the elderly population, and 60% - 65% of cases occur in the stomach ^[6]. Although GIST grows slowly, it has malignant potential. Its malignancy is mainly related to tumor size and mitotic figures. Relevant studies have pointed out that it may be unwise to use the definite term "benign" for any GIST. Some patients may experience malignant transformation or even metastasis. Therefore, active resection is generally required for GIST, especially for larger GISTs with a medium - or higher - risk level. There are different opinions among domestic and foreign scholars regarding small GISTs. The National Comprehensive Cancer Network (NCCN) recommends regular observation ^[7], but there are still certain risks in waiting and observation. The guidelines of the European Society of Gastrointestinal Endoscopy recommend removing histologically confirmed GISTs. This is because the true malignant potential of GIST can only be determined after resection. Although active surveillance can be chosen for lesions smaller than 2 cm, it imposes the burden of repeated EUS - assisted gastroscopic follow - up on young patients. Moreover, the compliance with surveillance recommendations is poor, possibly due to the lack of an optimal and evidence - based protocol for such active surveillance ^[8]. Many scholars believe that treating the tumor when it is small can prevent malignant transformation on the one hand, and endoscopic treatment has the advantages of being minimally

invasive, having fewer complications, and a shorter hospital stay on the other hand, thus being more beneficial to patients ^[9]. Since small tumors in the gastric proper muscular layer are located deep in the gastric wall, simple endoscopic mucosal resection (EMR) cannot achieve the therapeutic effect, and most cases are treated with endoscopic submucosal dissection (ESD). Currently, there are various endoscopic resection methods, each with its own advantages and disadvantages. We used the modified ESD method for gastric stromal tumors ≤ 2 cm and compared the treatment results between the traditional ESD treatment method and the modified ESD treatment method. All patients in both groups completed the ESD resection, and the complete resection rate was 100%. After follow - up at 6 months, 12 months, 24 months, and 36 months, no tumor recurrence was observed in either group. The operation time of the observation group was significantly shorter than that of the control group, and the hospitalization cost of the observation group was significantly less than that of the control group. There were 4 cases of complications in the control group, while no complications occurred in the observation group. Our research findings are as follows: (1) The surgical operation is simpler: In traditional ESD, a liquid cushion needs to be injected first to lift the diseased mucosa, and then a special mucosal cutting knife is used to gradually dissect the lesion. For the ligation and resection with a ligator with dental floss, the tumor can be sucked in by the ligator, and a

rubber band is released to form a false pedicle, which is then removed in combination with a snare. The operation is relatively simplified. The modified method optimizes the operation process and shortens the operation time. (2) Reduces the risk of intraoperative bleeding: The ligator can block the blood flow in the blood vessels around the tumor. In contrast, during the dissection process of ESD, bleeding is likely to occur due to reasons such as rich blood vessels in the lesion. The ligator with dental floss can ligate and stop bleeding in advance, making the surgical field clearer and facilitating the doctor's operation. (3) Optimizes the exposure of the surgical field: The dental floss can be fixed by tissue clips, which has a traction effect on the lesion and can better expose the lesion, facilitating the doctor to observe the entire lesion and its relationship with the surrounding tissues. In traditional ESD, when the anatomical position is complex or the lesion is difficult to expose, the field of view is relatively limited. For example, for lesions in the fundus of the stomach, duodenum and other parts, the traction of the dental floss can significantly improve the surgical field ^[10]. (4) The ligator with dental floss can better lift the lesion through the traction of the dental floss, enabling the doctor to perform precise operations under direct vision, avoiding excessive dissection and reducing the risk of perforation. Studies have shown that compared with the traditional surgical method, the endoscopic full - thickness resection assisted by dental floss traction

can reduce the occurrence of minor complications such as post - operative electrocoagulation^[11]. (5) Ligation and resection using a ligator with dental floss is relatively simple to operate and can reduce the use of some instruments, thereby lowering the medical costs for patients. (6) Complete tumor tissue can be obtained for pathological and immunohistochemical examinations to evaluate the nature of the tumor, its malignancy, and the patient's prognosis^[12]. The modified ESD for treating small gastric stromal tumors shortens the operation time and improves the operation efficiency. The modified ESD reduces the incidence of intraoperative and postoperative risks (such as perforation and bleeding) and the occurrence of postoperative adverse events (such as infection). However, the limitation of the modified technique lies in its poor surgical effect for tumors of a certain size (e.g., ≥ 2 cm) and tumors growing in specific layers (serosa layer). In conclusion, the modified ESD for treating small gastric stromal tumors is effective and safe. It can completely resect the lesion and obtain complete pathological diagnostic data, which is of certain significance for evaluating the nature of the tumor, its malignancy, and the patient's prognosis. The modified ESD not only focuses on the short - term effects of technical improvement but also provides a standardized reference for the minimally invasive treatment of gastric stromal tumors through multi - dimensional evaluation of efficacy and safety, promoting the precise application of minimally invasive

techniques. However, further research is needed on issues such as the long - term prognosis after the treatment of small gastric stromal tumors, the selection of treatment regimens for small gastric stromal tumors of different risk levels and growth types, and the prognosis after treatment.ion syndrome .

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Writing – review & editing: Fanglai Zhu.

Acknowledgements

Not applicable.

Authors' contributions

FLZ conceptualized the case report and did the procedure. ZWH and LD prepared the initial drafting of the paper. ZWH and FLZ did the research, editing and final drafting of the paper. ZWD and FL Z contributed equally. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This subject has been approved by the ethics committee of Anqing first people's hospital.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Funding

Nil.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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