

# ENDOSCOPIC DILATION OF GASTROJEJUNAL ANASTOMOSIS AFTER GASTRIC BYPASS

## *Dilatação endoscópica de anastomose gastrojejunal após bypass gástrico*

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**ABSTRACT – Introduction** - Roux-en-Y gastric bypass may result in stenosis of the gastrojejunal anastomosis. There is currently no well-defined management protocol for this complication. **Aim** - Through systematic review, to analyze the results of endoscopic dilation in patients with stenosis, including complication and success rates. **Methods** - The PubMed database was searched for relevant studies published each year from 1988 to 2010, and 23 studies were identified for analysis. Only papers describing the treatment of anastomotic stricture after Roux-en-Y gastric bypass were included, and case reports featuring less than three patients were excluded. **Results** - The mean age of the trial populations was 42.3 years and mean preoperative body mass index was 48.8 kg/m<sup>2</sup>. A total of 1,298 procedures were undertaken in 760 patients (81% female), performing 1.7 dilations per patient. Through-the-scope balloons were used in 16 studies (69.5%) and Savary-Gilliard bougies in four. Only 2% of patients required surgical revision after dilation; the reported complication rate was 2.5% (n=19). Annual success rate was greater than 98% each year from 1992 to 2010, except for a 73% success rate in 2004. Seven studies reported complications, being perforation the most common, reported in 14 patients (1.82%) and requiring immediate operation in two patients. Other complications were also reported: one esophageal hematoma, one Mallory-Weiss tear, one case of severe nausea and vomiting, and two cases of severe abdominal pain. **Conclusion** - Endoscopic treatment of stenosis is safe and effective; however, further high-quality randomized controlled trials should be conducted to confirm these findings.

**HEADINGS** – Bariatric surgery. Anastomosis, Roux-en-Y. Gastroenterostomy.

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**RESUMO – Introdução** – Bypass gástrico em Y-de-Roux pode resultar em estenose de anastomose gastrojejunal. Não há protocolo de tratamento bem definido para essa complicação. **Objetivo** – Analisar os resultados da dilatação endoscópica em pacientes com estenose, através de revisão sistemática, incluindo complicações e taxa de sucesso. **Métodos** – Foi realizada busca dos estudos relevantes publicados de 1988 a 2010 na base de dados do PubMed, sendo identificados 23 estudos para análise. Apenas os que descreviam o tratamento de estenose de anastomose após bypass gástrico em Y-de-Roux foram incluídos e relatos de caso que apresentavam menos de três pacientes foram excluídos. **Resultados** – A idade média da população foi de 42,3 anos e o índice de massa corpórea pré-operatório médio foi de 48,8 kg/m<sup>2</sup>. No total, 760 pacientes (81% feminino) foram submetidos a 1298 procedimentos, sendo realizadas 1,7 dilatações por paciente. Balões Through-the-scope foram utilizados em 16 estudos (69,5%) e dilatador de Savary-Gilliard em quatro. Apenas 2% dos pacientes necessitaram revisão cirúrgica após a dilatação; a taxa de complicações reportada foi de 2,5% (n=19). A taxa de sucesso anual foi maior que 98% nos anos 1992 a 2010, exceto por uma de 73% em 2004. Sete estudos relataram complicações, sendo perfuração a mais comum, relatada em 14 pacientes (1,82%), necessitando operação imediata em dois pacientes. Outras complicações foram também relatadas: um hematoma esofágico, uma lesão de Mallory-Weiss, um caso grave de náusea e vômito, e dois casos de dor abdominal importante. **Conclusão** – Tratamento endoscópico de estenose é seguro e eficaz; entretanto, mais estudos controlados randomizados devem ser realizados a fim de confirmar esses achados.

**DESCRITORES** - Cirurgia bariátrica.  
Anastomose em Y-de-Roux.  
Gastroenterostomia.

## INTRODUCTION

Among the many options for surgical treatment of obesity, Roux-en-Y gastric bypass (RYGB) is currently one of the most performed procedure<sup>20,28</sup>. The gastrojejunostomy is purposely constructed with a small diameter, and the rate of stricture can be as high as 27% after laparoscopic procedures<sup>7</sup>. Stricture usually occurs at approximately one month after bariatric surgery<sup>4</sup>, and may be classified as early or late (within or longer than 30 days after operation, respectively)<sup>12</sup>.

Review of the literature does not indicate the gold standard treatment for stricture. Since reoperation is rarely performed because of its complexity and the resulting morbidity, endoscopic dilation treatment seems to be a global trend<sup>24,27</sup>. Perugini et al. found that more than half of the complications after RYGB in their series were due to anastomotic stricture, demonstrating the morbidity associated with this outcome<sup>21</sup>.

There is no consensus on whether the Savary-Gilliard bougie or the through-the-scope (TTS) balloon is the best device for the endoscopic treatment of anastomotic stenosis<sup>12</sup>. Most studies advocate the TTS balloon to treat stenosis, but two studies achieved success using Savary-Gilliard bougies<sup>11,12</sup>. Here is discussed the various aspects of each method, including device diameters, dilation times, and complications.

This systematic review analyzed published trials describing the treatment of stricture of the gastrojejunal anastomosis after RYGB, with emphasis on endoscopy as an effective and safe method for treating this condition.

## METHODS

### Search strategy

The literature search was conducted during January 2010. Was searched the PubMed electronic database using the following terms: ("Gastric Bypass/adverse effects"[Mesh] OR "Gastroenterostomy/adverse effects"[Mesh] OR "Anastomosis, Roux-en-Y/adverse effects"[Mesh]) AND ("Dilatation" OR "Reoperation"), to identify relevant studies describing the stenosis' treatment on gastrojejunal anastomosis after RYGB.

### Study selection

Initially, titles and abstracts were screened, and original articles were evaluated if they included patients who had undergone RYGB and had any complications related to this surgery. Fifty-two of the studies reported on stenosis of the gastrojejunal anastomosis after RYGB. Of these, the 23 papers which reported on dilation to treat stricture were

included. No randomized controlled trials of treatment for stricture after RYGB were identified. The electronic database was searched over a period of 23 years, and inclusion and exclusion criteria were determined to define the study population. Two researchers examined the full texts of the selected studies.

Studies that met the following criteria were selected: original article, English language, published between 1988 and 2010, full text available, reports of patients with anastomotic stenosis after RYGB and description of treatment for this complication. Review articles, commentary, editorials, sample size smaller than three patients, duplicate articles or not bariatric surgery were excluded from this systematic review. Furthermore, studies that did not report the following data were also excluded: number of patients, type of dilator, and number of dilations.

All potential differences in interpretation between the reviewers were discussed, to ensure that all the articles reviewed presented a satisfactory level of evidence.

### Identified studies

The literature search described above yielded 252 studies. A total of 23<sup>1,2,3,4,6,8,9,10,11,12,16,17,18,19,20,22,23,24,25,26,28,29,30</sup> published from 1988 to 2010 were abstracted and included in the systematic review. Figure 1 shows the results of initial searches for inclusion.

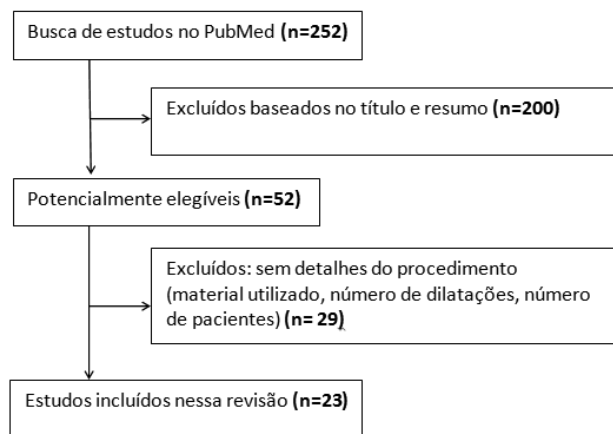


FIGURE 1 - Flow diagram of trials for the systematic review

### Data abstraction

Data were abstracted from every selected study. The following variables were retrieved from the full text of each report: 1) number of patients, 2) type of stapler, 3) setting of procedure, 4) type of anesthesia, 5) type of dilator/balloon, 6) diameter of dilator/balloon, 7) number and duration of dilations, 8) complications and 9) surgical revision (Table 1).

**Data analysis**

Was summarized the available information from all trials which reported their results. Analyses were performed only on the studies which met the inclusion criteria. Data as number of dilation and surgical procedures were analyzed using Statistical Package for Social Sciences (SPSS) software.

Some variables regarding the type of anesthesia, type of stapler, and anastomosis technique were interpreted using a "multiple answers" method, compatible with SPSS.

As this systematic review did not aim to compare studies from only a statistical point of view, descriptive and exploratory analyses were also employed. Quantitative and qualitative variables were extracted and the mean, maximum, minimum, and standard deviation were calculated.

If a study failed to report any of the variables, this was classified as "not reported." Was then analyzed the results comparing only the available data.

**RESULTS**

A total of 760 subjects were included in the 23 selected studies. Nineteen were based in the USA, one in

Spain, and the remaining three in South America (Brazil, Chile and Argentina). Twelve of the 23 studies (52.17%) were published from 2007 to 2009 and only one of the included studies was published in 2010.

All included studies reported endoscopic or radiologic interventions for stricture of the gastrojejunal anastomosis after RYGB. The mean age of patients in the trial populations was 42.3 years (range 17–72 years). Every study that reported patient characteristics included both females and males, and approximately 81% of all patients were female. Sixteen studies reported the mean preoperative body mass index (BMI), and the overall mean BMI was 48.8 kg/m<sup>2</sup> (range 35–103 kg/m<sup>2</sup>).

Eighteen studies described the method of RYGB surgery, and all used laparoscopy. There were no randomized controlled trials. Fourteen studies were retrospective, five were prospective, and four did not report their design. A total of 1,298 dilations in 760 patients were reported, which is an average of 1.7 dilations per patient.

Regarding the number of patients undergoing endoscopic dilatation per year, there was a greater number between the years 2007 and 2010, comprising approximately 66%, with the highest annual number of procedures in 2008 (25.8%).

One study, which included 40 patients with anastomotic stricture, reported a case of completely

**TABLE 1 -** Data extracted from each study selected

Author	n	Stapler	Setting	Anesthesia	Dilations (n)	Balloon/ Dilator	Balloon/ Dilator (mm)	Duration (min)	Complications (n)	Success (%)	Reoperation (n)
Ahmad J et al. 2003 <sup>1</sup>	14	SNE	NR	NR	23	TTS	10 - 25	1	No	100	0
Alasfar F et al. 2009 <sup>2</sup>	29	circular	outpatient	conscious sedation	36	TTS	10 - 12	1	No	100	0
Barba CA et al. 2003 <sup>3</sup>	24	circular	outpatient	conscious sedation	33	TTS	8 - 13	1	No	100	0
Bell RL et al. 2003 <sup>4</sup>	3	linear	outpatient	conscious sedation	6	Savary or TTS	5 - 20 (Savary) 6 - 20 (balão)	1-3	No	100	0
Caro L et al. 2008 <sup>6</sup>	111	NR	NR	conscious sedation	200	TTS	6 - 18	1	Yes	100	0
Catalano MF et al. 2007 <sup>8</sup>	26	circular	outpatient	conscious sedation	63	TTS	8 - 15	1	No	100	0
Costa AF et al. 2009 <sup>9</sup>	30	NR	outpatient	conscious sedation	48	Savary or TTS	max 12,8 (Savary) max 14 (TTS)	NR	No	100	0
Dolce CJ et al. 2009 <sup>10</sup>	11	circular	NR	NR	11	TTS	10 - 18	NR	No	90,9	1
Escalona A et al. 2007 <sup>11</sup>	53	hand-sewn	outpatient	NR	71	Savary	max 11	NR	Yes	100	0
Fernández-Esparrach G et al. 2008 <sup>12</sup>	24	circular	outpatient	conscious sedation	38	Savary	7 - 12,8	NR	No	100	0
Lee JK et al. 2009 <sup>16</sup>	40	NR	NR	NR	86	TTS	6 - 18	1	No	100	0
Mathew A et al. 2009 <sup>17</sup>	58	circular or linear	NR	NR	125	NR	6 - 12	NR	Yes	100	0
Mishkin JD et al. 1988 <sup>18</sup>	7	linear	NR	NR	7	Balloon	12 - 15	NR	No	42,8	4
Nguyen NT et al. 2003 <sup>19</sup>	29	circular	outpatient	conscious sedation or general anesthesia	35	TTS	18	±1	No	100	0
Peifer KJ et al. 2007 <sup>20</sup>	43	circular or hand-sewn	NR	NR	56	TTS	9 - 20	NR	Yes	97,6	1
Rajdeo H et al. 1989 <sup>22</sup>	8	linear	inpatient	conscious sedation or general anesthesia	11	TTS	6 - 20	2	No	87,5	1
Rossi TR et al. 2005 <sup>23</sup>	38	circular	NR	conscious sedation	61	NR	NR	2	Yes	100	0
Ryskina KL et al. 2010 <sup>24</sup>	58	circular or hand-sewn	NR	NR	117	TTS	8 - 15	NR	No	100	0
Sanyal AJ et al. 1992 <sup>25</sup>	20	NR	outpatient or inpatient	conscious sedation	23	TTS	10 - 12	1	No	100	0
Schwartz ML et al. 2004 <sup>26</sup>	30	linear	NR	NR	68	Balloon	10 - 18	NR	Yes	73,3	8
Takata MC et al. 2007 <sup>28</sup>	15	circular or linear	outpatient	conscious sedation	22	TTS	6 - 20	NR	No	100	0
Ukleja A et al. 2008 <sup>29</sup>	61	circular or linear	NR	conscious sedation	128	TTS	6 - 18	1	Yes	100	0
Vance PL et al. 2002 <sup>30</sup>	28	NR	NR	conscious sedation	41	Balloon	20	1-3	No	100	0
<b>TOTAL=23 artigos (100%)</b>	<b>760</b>	<b>15 (65.2%) stapler 2 (8.7%) stapler or hand-sewn 1 (4.3%) hand-sewn 5 (21.7%) NR</b>	<b>9 (39.1%) outpatient 1 (4.3%) inpatient 1 (4.3%) outpatient or inpatient 12 (52.1%) NR</b>	<b>12 (52.1%) conscious sedation 2 (8.7%) conscious sedation or general anesthesia 9 (39.1%) --&gt; NR</b>	<b>1298</b>	<b>17 (73.9%) Balloon 2 (8.7%) Savary 2 (8.7%) Savary or Balloon 2 (8.7%) NR</b>	<b>Savary: 5 - 20 Balloon: 6 - 25</b>	<b>13(56.5%) 1-3 min 10 (43.4%) NR</b>	<b>7 (30.4%) Yes 16 (69.6%) No</b>	<b>98</b>	<b>15</b>

NR: Not reported. TTS.; trough the scope balloon. Savary: Savary-Gilliard dilator.

obstructed stenosis treated with a needle-knife in the operating room under laparoscopic control<sup>16</sup>. Gastrointestinal anastomosis was regularly performed using a mechanical stapler (linear or circular) in 16 studies, accounting for almost 70% of the series.

Five studies did not state the method of anastomosis. Of the 18 studies describing the method of anastomosis, 12 (70.5%) used a circular stapler and, five of them, also used either manual suturing<sup>20,24</sup> or a linear stapler<sup>17,28,29</sup>. Four studies used a linear stapler only<sup>4,18,22,26</sup> and one study used manual suturing only<sup>11</sup>. One study did not describe the type of stapler<sup>1</sup>. Manual suturing resulted in a higher number of dilations compared with using staplers, but a lower average number of dilations per patient (Table 2).

**TABLE 2 – Correlation between aspects of dilation and type of anastomosis (manual or mechanical)**

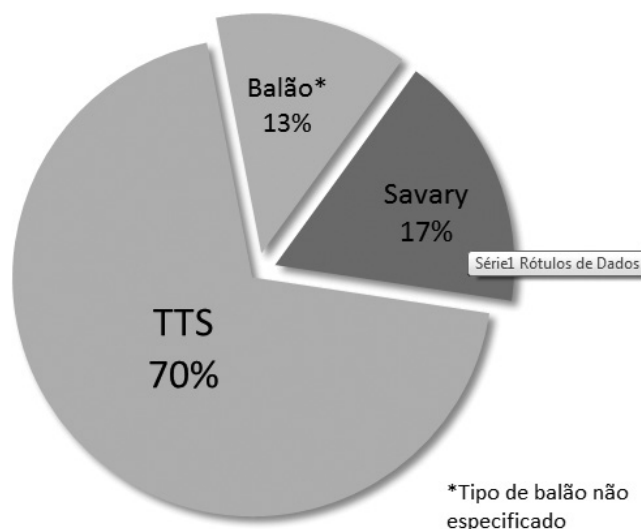
Type of stapler	Average				
	Maximum diameter(TTS)	Number of dilations	Maximum time of dilation (min)	Average dilation	Success rate
Stapler*	25,00	23,00	1,00	1,64	100,00
Linear stapler	20,00	23,00	2,50	1,66	75,92
Circular stapler	16,56	60,42	1,17	1,62	99,05
Hand-sewn suture	--	71,00	--	1,34	100,00
<b>Total</b>	<b>17,25</b>	<b>56,91</b>	<b>1,46</b>	<b>1,62</b>	<b>95,31</b>

\* Not specified the stapler type

Eleven studies specified the setting where endoscopic dilation was performed. The procedure was performed on an outpatient basis in 10 of these studies (91%), unless the patients were already hospitalized<sup>8</sup> or needed hospital admission due to intolerance of solids or liquids<sup>3</sup> or dehydration<sup>23</sup>. In one study, the procedures took place in hospital due to dehydration<sup>19</sup>.

Fourteen studies reported the type of anesthesia used. Conscious sedation was the most commonly used anesthetic technique for endoscopic treatment (86%). Only two of these 14 studies (14%) reported the use of either sedation or general anesthesia.

Two studies did not give details regarding the type of dilator used. Seventeen studies (81%) used balloons, and two Savary-Gilliard bougies exclusively<sup>11,12</sup>. Sixteen performed dilation using TTS, with two of them also using Savary-Gilliard bougies<sup>4,9</sup>. Dilations using Savary-Gilliard bougies were performed in a total of four studies (Figure 2). The use of other types of balloon such as angioplasty-type polyethylene balloon catheters<sup>30</sup>, polyvinyl chloride and polyethylene balloons<sup>20</sup>, and pneumatic balloons<sup>26</sup> was also reported. One study did not state the type or diameter of dilator used<sup>23</sup>. Savary-Gilliard bougies ranged in diameter from 5 mm to 20 millimeters, and balloons ranged in diameter from 6 mm to 25 mm. The mean number of dilations reported per study was 57, and the mean number of dilations per patient was 1.62 (Table 3).



**FIGURE 2 - Distribution of dilation devices**

**TABLE 3 – Aspects of endoscopic dilatation**

Variable	n	Minimum	Mean	Maximum	Standard deviation
Maximum diameter (Savary)	5	11,00	13,72	20,00	3,59
Maximum diameter (TTS)	16	12,00	17,25	25,00	3,53
Number of dilations	23	6,00	56,91	200,00	47,67
Maximum time of dilation (min)	13	1,00	1,46	3,00	,78
Average dilation	23	1,00	1,62	2,42	,42
Success rate	23	42,86	95,31	100,00	13,00
<b>Total</b>	<b>103</b>	<b>73,86</b>	<b>186,28</b>	<b>350,42</b>	<b>68,99</b>

Thirteen studies reported the dilation time, which varied from 1 to 3 min. Eight studies (61.5%) mentioned 1 min, two (15.4%) 1–3 min, and two other (15.4%) 2 min. One (8%) left the balloon inflated until the waist disappeared, followed by another dilation lasting 30–60 s<sup>19</sup>.

Seven studies reported complications<sup>6,11,17,20,23,26,29</sup>(Table 4). Perforation was the most common complication, reported in 14 patients (1.82%) and requiring immediate operation in two patients<sup>26</sup>. Complications were reported in five other patients: one esophageal hematoma<sup>6</sup>, one Mallory-Weiss tear (it was not clear if this was iatrogenic or was present before starting the procedure)<sup>20</sup>, one developed severe nausea and vomiting<sup>23</sup>, and two developed severe abdominal pain<sup>29</sup>.

Out of all 760 patients in the review, 15 (2%) required surgical revision for recurrent stenosis. A greater than 98% annual success rate was shown for endoscopic dilation each year from 1992 to 2010, except for a 73% success rate in 2004, which may be explained by the gastrojejunostomy band or balloon type used<sup>26</sup>.

## DISCUSSION

Endoscopic dilation has become the elected treatment for gastrojejunostomy anastomosis stricture after RYGB, due to the low morbidity rate of this procedure. However there are no studies well designed

**TABLE 4** – Complications of the dilation procedures

Complications (n)	Treatment
Hematoma of the esophagus (n=1) (0.13%)	n=1 treated medically using conservative measures and intravenous antibiotics <sup>5</sup>
Perforations (n=14) (1.86%)	n=2 operated on immediately <sup>26</sup> . n=2 antibiotics, intravenous hyperalimentation, and GI tract rest <sup>26</sup> . n=3 laparoscopic surgical exploration, and supportive treatment postoperatively (bowel rest, antibiotics intravenously for 5–7 days, and drains placement) <sup>29</sup> . n=1 admitted for observation and discharged without symptoms after 2 days <sup>11</sup> . n=2 treated medically using conservative measures and intravenous antibiotics <sup>6</sup> . n=4 treatment used to treat complications was not reported <sup>17</sup>
Mallory-Weiss tear (n=1) (0.13%)	n=1 procedimento suspenso e repetido com sucesso após uma semana. De acordo com os autores, não ficou claro se a lesão foi iatrogênica ou prévia ao procedimento <sup>20</sup>
Severe nausea and vomiting (n=1) (0.13%)	n=1 hidratação <sup>26</sup>
Severe abdominal pain (n=2) (0.26%)	n=2 internação para observação e alta com 24 h, após estudo do TGI alto normal e ausência de sintomas <sup>29</sup>
<b>TOTAL= 19 complications (2.53%) / 760 patients</b>	

GI: gastrointestinal. UGI: upper gastrointestinal

that indicates the gold-standard endoscopic treatment and no consensus on whether the early endoscopic procedure is safe or not.

All of the 23 studies reviewed described case series of clinical interventions, with non-randomized patient allocation, and only five had a prospective design. Four studies did not report their design. The low level of evidence presented by these individual studies encouraged the current authors to undertake this systematic review.

All the studies published during the 1990s did not report the mean age, gender, and preoperative BMI of patients. The majority of patients in the studies reviewed were female. For example, the study by Nguyen et al., reported that 96.5% of patients were female<sup>29</sup>. However, there were no further discussion about female gender being a risk factor for gastrojejunal anastomotic stricture. A total of 1,298 dilations were performed in the 760 patients included in the review, which was an average of 1.7 dilations per patient. This was consistent with the data reported by Caro et al.<sup>6</sup>, who reported 1.8 dilations per patients. The studies indicated that this complication of surgery could be resolved with a small number of dilation procedures, with endoscopy being the best treatment choice. The literature commonly indicates that the average number of dilations needed is between one and two. Most patients (398/760) had clinical resolution after a single procedure.

Even after successful dilation, some cases proved to be refractory to this therapy, with recurrent stricture requiring other forms of treatment. Patients with recurrent stricture after two dilations, or with gastrojejunostomy fibrosis, should be treated with stenostomy, using a needle-knife to make incisions in two to four quadrants of the stricture<sup>16</sup>.

More than 69% of anastomoses were performed using a stapler, with the circular stapler being the

most common. Five studies did not report the type of stapler used, which prevented a detailed analysis of gastrojejunal anastomoses. More than one study found that using a larger circular stapler (25 mm versus 21 mm) resulted in a lower stenosis rate<sup>19,23</sup>, and that using a circular stapler resulted in a higher stenosis rate than using linear stapler<sup>5</sup>.

Only three studies (13%) used manual suturing to perform anastomoses, which illustrates the challenging nature of the RYGB procedure and the knowledge required to perform it. Escalona et al. reported the only study which used only manual suturing in gastrointestinal anastomoses, with a single-layer continuous suture in open surgery and a double-layer continuous suture in laparoscopic surgery, using polyglecaprone 25-3.0<sup>11</sup>. Kravetz et al.<sup>15</sup> reported a lower stenosis rate in manually sutured anastomoses compared with stapled anastomoses. Galvão Neto et al. reported a statistically significant difference in stenosis rates between non-absorbable sutures (polyester, 8.26%) and absorbable sutures (polydioxanone, 1.6%) [not published data].

Dilations were usually undertaken on an outpatient basis, except in the studies by Barba et al. who reported two patients who were hospitalized due to intolerance of solids or liquids after dilation, and Takata et al. who reported seven patients who were admitted to hospital for dehydration<sup>3,28</sup>. Unfortunately, 12 studies did not report the settings of the endoscopic procedures.

Details regarding the method of anesthesia were not reported in 39.13% of studies. Twelve studies mentioned that the procedures were undertaken with conscious sedation.

Ahmad et al.<sup>1</sup> reported that they were able to detect endoscopic evidence of stenosis with localized edema and inflammation around the anastomosis, and proposed dilation in patients with these features even if the patients were asymptomatic. There is no consensus regarding the best way to manage stenosis of the gastrojejunal anastomosis. Most studies used endoscopic treatment with balloon dilation, with the majority of authors preferring this method because they assumed that it was less likely to cause perforation. Escalona and Fernández-Esparrach used Savary-Gilliard bougies for dilation, with low complication rates, but this method may cause anastomotic leaks if used soon after bypass surgery<sup>11,12</sup>.

When choosing a balloon size, it is essential to evaluate the patient's symptoms and assess the tightness of the stenosis. A hydrostatic balloon can be gradually inflated with saline solution under direct vision, controlled by an insufflator connected to a manometer.

There was an upwards trend in the number of dilations per year, but the mean number of dilations per patient was stable. This apparent contradiction is explained by the increasing number of patients per year. The smallest diameter of dilator reported in the studies

was 6 mm and the largest was 25 mm. An initial size of 12 mm seemed to be the best option. Huang et al.<sup>13</sup> proposed that endoscopic dilation should not exceed 15 mm, to avoid weight regain, and this same author proposed in a later paper that the TTS balloon should be inflated to at least 15 mm to reduce the recurrence rate of stenosis<sup>14</sup>.

Vance et al. reported perforations in three primary dilations using a 15 mm balloon<sup>30</sup>, but some initial dilations used balloons up to 20 mm in diameter<sup>29</sup>. Escalona et al.<sup>11</sup> and Fernández-Esparrach et al.<sup>12</sup> used Savary-Gilliard bougies for endoscopic therapy, reporting 71 and 38 dilation procedures, respectively. These authors reported successful dilation in all their patients. This procedure has a lower cost compared with using balloons, but has not gained popularity.

Procedure duration was not reported in 43.47% of the studies. Due to the different methods used in the 23 papers, it was difficult to perform comparative statistic analyses. The time from surgery to the emergence of symptoms was not precisely recorded, but most studies tended to diagnose stenosis and perform endoscopic dilation at approximately one month after RYGB, except for Mishkin et al.<sup>18</sup> and Rossi et al.<sup>23</sup>, who undertook early dilation at seven and 10 days, respectively.

Ryskina et al.<sup>24</sup> reported that dilator type, and initial and maximum balloon size, were determined by the gastroenterologist at the time of the procedure. The literature did not establish a recommended time for dilation procedures. Most authors dilated for 1 min, but the companies that manufacture the devices have not determined a recommended dilation time. The procedure should be stopped if the patient experiences abdominal pain, but otherwise the time of dilation depends on the preference and experience of the endoscopist. Dilation time did not exceed 3 min in any of the studies. The question on whether this short time represents a limit for this treatment, or whether the time could be prolonged to improve dilation results, has not been answered.

Regarding complications related to endoscopic treatment, Wetter reported a perforation and staple line dehiscence rate of 2-6% after TTS balloon dilation<sup>27</sup>. In this review, dilation was associated with low morbidity and no mortality. The most common complication (perforation) occurred in 1.86% of patients, and most were treated conservatively. Ukleja et al. reported that three patients required surgical exploration, which did not find the perforation site; these patients were treated with fasting, drain placement, and intravenous antibiotics, with satisfactory outcomes<sup>29</sup>.

More than two decades ago, Mishkin et al.<sup>18</sup> introduced endoscopic dilation of stenosis of gastrojejunal anastomosis after RYGB, with disappointing results, but their report resulted in widespread use of this procedure to treat stenosis, reducing the need for reoperation.

Patients who develop recurrent stenosis or fibrosis

of their gastrojejunal anastomosis after two dilations should be treated with stenostomy.

Stenosis of the gastrojejunal anastomosis required surgical treatment before endoscopic dilation was reported in the literature. Surgery is now seldom required for the treatment of stenosis, thereby reducing the morbidity inherent in the RYGB operation.

Further prospective, randomized, controlled trials should be conducted to further evaluate dilation in patients with stenosis of the gastrojejunal anastomosis after RYGB.

## CONCLUSION

Endoscopic dilation is a safe and effective procedure with a low morbidity rate, which should be performed by skilled and experienced professionals with the correct equipment. This review illustrates that stricture of the gastrojejunal anastomosis is a common complication after gastric bypass surgery, which is usually diagnosed by endoscopy. Endoscopic dilation is a safe and effective procedure and a global trend on gastrojejunal anastomosis stricture treatment.

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