



# Revisional Bariatric Surgery for Weight Regain and Refractory Complications in a Single MBSAQIP Accredited Center: What Are We Dealing with?

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## Abstract

**Background** Revisional surgery is the fastest growing area in bariatric surgery, constituting 13.6% of all procedures performed as of 2015. This reflects a rising need to treat adverse sequelae of primary bariatric procedures. Despite the increase in revisions, their safety and efficacy remain controversial. The objective of this study is to review the experience of revisional bariatric surgery in our center and the relevant literature to date.

**Methods** We performed an IRB-approved review of prospectively collected data from all patients undergoing revisional bariatric surgery between 2012 and 2015. Due to patient heterogeneity, we divided subjects into two groups: patients who underwent surgery for weight regain (WR) and those who underwent surgery to address refractory complications (RC) related to their primary bariatric procedure. Demographics, indications, and outcomes of each group were compared using Fisher's exact test, Mann-Whitney rank sums, and chi-square tests. We also divided WR patients based on their primary index procedure and analyzed them separately.

**Results** We performed a total of 84 procedures over 4 years. Forty-three patients (53.6%) underwent surgery for WR and 41 (46.4%) for RC. The variety and distribution of primary bariatric procedures were gastric band (40%), gastric bypass (35.4%), sleeve gastrectomy (22%), and vertical banded gastroplasty (3.7%). The indications for revisional surgery due to RC included gastroesophageal reflux disease, internal hernia, gastro-gastric fistula, marginal ulcer, excess weight loss, and pain. Overall complication rate was 14.3% (three early, nine late); there was one leak. Five patients required a reoperation (5.9%; two early, three late). Excess weight loss varied from 31.5–79.1% 12 months after revision.

**Conclusion** Patients presenting to our center for revisional surgery do so for either WR or RC, most commonly following gastric banding. Revisional bariatric surgery can be performed with low complication rates and with acceptable 12-month weight loss, though not with the same safety as primary procedures.

**Keywords** Revision bariatric surgery · Weight regain · Refractory complications · Conversion · Gastric band · Sleeve gastrectomy · Gastric bypass

## Introduction

Revisional surgery is the fastest growing category of bariatric procedures, more than doubling from 6% of all bariatric

procedures in 2013 to 13.5% in 2015 [1, 2]. Bariatric surgical volume has grown yearly since 2011, and now exceeds 200,000 cases annually [2, 3]. Each new primary operation adds to the rapidly expanding cohort of potential candidates for revisional

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bariatric surgery. Long-term rates of revisional surgery have been estimated as high as 56% [4], including 40–50% of patients after placement of an adjustable gastric band (AGB, [5]).

Despite the demand for revisional surgery, its safety and efficacy remain controversial. A 2014 review of bariatric revision cohorts from 2004 to 2013 by Brethauer et al. concluded that while revisional bariatric surgery is a useful tool in the armamentarium of experienced surgeons, the indications and outcomes are poorly characterized, and that these procedures, while safe, present higher complication rates than primary bariatric surgeries [6]. This reflects the individualized approach for these procedures and the varying institutional protocols for evaluating these patients. Furthermore, the advancements in minimally invasive technology that have made primary bariatric surgeries safer than open procedures [7] have not been similarly substantiated for revisional procedures, although open revisions incur morbidity rates as high as 41% [4, 8].

We have previously reported our data regarding sleeve conversions for weight loss and refractory gastroesophageal reflux disease (GERD, [9]). In this study, we aim to classify all revisional bariatric surgery performed at our institution and further elucidate its safety and efficacy.

## Methods

We conducted a retrospective study of patients undergoing revisional bariatric surgery from January 2012 to December 2015. Data was acquired from a prospectively maintained Metabolic and Bariatric Surgery Accreditation and Quality Improvement Project (MBSAQIP)-enrolled database. The Allscripts electronic medical record (Allscripts Healthcare Solutions, Chicago IL) was used to extract patient demographics, surgical history, complications, and postoperative outcomes. As this study involved a retrospective review of a prospectively maintained, de-identified database, obtaining informed consent did not apply, and we obtained an exemption from informed consent by our center's Institutional Review Board. Readmission was defined as unscheduled outpatient or inpatient medical care related to the surgery within 30 days.

### Inclusion Criteria

- Age  $\geq 18$  and attendance at an informational seminar and support group
- Clearance for surgery by a registered dietician and certified social worker
- Negative pregnancy test
- American Society of Anesthesiology scores 1–3
- Ability to understand instructions and comply with all study requirements
- No contraindication for procedure based on upper endoscopy findings

- Preoperative cardiac consultation for risk stratification
- Evaluation by a sleep medicine specialist to identify risk factors for sleep apnea, with treatment for at least 2 weeks prior to surgery when deemed appropriate
- Attendance of a team meeting 2 weeks prior to surgery to educate patients and review expectations following surgery

### Exclusion Criteria

- Presence of uncontrolled mental disorder
- Emergency procedure
- Active eating disorder such as bulimia nervosa, binge eating disorder, or compulsive overeating
- Underlying endocrine disorder (e.g., hypothyroidism)
- Failure to comply with preoperative regimen
- Planned pregnancy in the next 18 months
- Schizophrenia or psychosis
- Inpatient psychiatric care in the previous 2 years

Postoperative complications were categorized into minor versus major and early ( $\leq 30$  days post-surgery) versus late ( $> 30$  days) according to American Society of Metabolic and Bariatric Surgery standardized reporting criteria [10]. Minor complications include events requiring medical therapy or extended hospitalization. Major complications include high-risk events requiring radiological, endoscopic, or surgical intervention.

Due to the heterogeneity of our cohort, we divided the patients into two groups: those who underwent surgery for weight regain (WR) and those who presented for refractory complications (RC). Patients who presented with both RC-related symptoms and WR were assigned to the WR group.

### Preoperative Workup

#### Weight Regain Pathway

Patients whose body mass index (BMI) and comorbidities qualified them for bariatric surgery (BMI  $\geq 40$  kg/m<sup>2</sup> alone or  $\geq 35$  kg/m<sup>2</sup> with obesity-associated diseases) within 24 months following their index procedure were considered for revision. These patients were required to follow 3–6 months of a physician-guided medical weight loss regimen in addition to dietician and psychiatrist evaluations. A preoperative upper gastrointestinal series and diagnostic upper endoscopy were performed to determine anatomy; computed tomography was used selectively to clarify equivocal findings of other diagnostic modalities (Fig. 1).

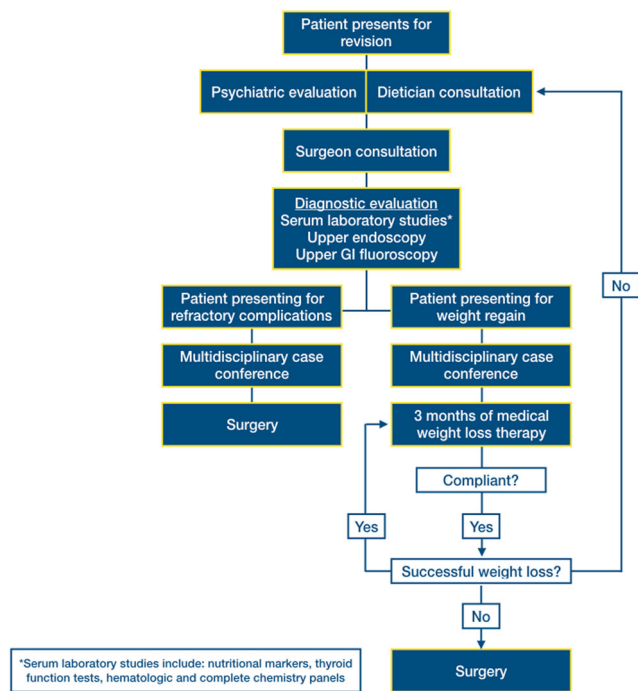


Fig. 1 Revision clinical pathway

**Refractory Complications Pathway**

Depending on the index surgery, postoperative complications included GERD, gastro-gastric fistula, internal hernia, anastomotic stricture, and chronic marginal ulcer. All patients initially underwent upper GI fluoroscopy and endoscopy; patients experiencing GERD also underwent ambulatory pH monitoring. This was followed by non-operative therapy including proton pump inhibitors, cytoprotective medication, endoscopic dilatation, dietary modification, or other interventions as indicated. Again, computed tomography was used selectively to clarify equivocal findings of other diagnostic modalities. Failure to resolve complications with non-operative therapies prompted consideration for surgical revision.

**Operative Technique**

All cases were performed laparoscopically using a 5-trocar technique with a Nathanson liver retractor. Patients were fitted with intermittent pneumatic compression devices and received perioperative DVT prophylaxis with subcutaneous heparin or enoxaparin in the preoperative holding unit. Patients also received a single dose of antibiotic 30 min prior to the procedure. Unless the procedure was band removal, all patients had a urinary catheter placed after intubation. An upper endoscopy was performed intra-operatively to check for bleeding and leak. For biliopancreatic diversion with duodenal switch (BPD-DS) and Roux-en-Y gastric bypass (RYGB), stapled

and hand sewn anastomoses were selectively used depending on tissue thickness and mobilization. For sleeve gastrectomy (SG), a 36 French bougie was used for sleeve calibration. A 19 French Blake drain was placed intra-abdominally in all cases. Exposed staple lines were oversewn using absorbable suture. No staple line buttress materials were used.

**Postoperative Management**

All patients were made NPO (except in the case of simple band removal) and admitted to a telemetry floor with continuous cardiac monitoring. On postoperative day 1, patients who underwent stapling or division of the gastrointestinal tract had upper gastrointestinal radiographic series performed to assess for leaks; if negative, a clear liquid diet was started.

**Statistical Analysis**

We compared demographics, indications, and outcomes between the two groups using Fisher’s exact test, Mann-Whitney rank sums, and chi-square tests. We also divided WR patients based on their primary index procedure and analyzed them separately. Descriptive data are reported due to heterogeneity and low statistical power.

**Results**

From January 2012 to December 2015, 1679 patients underwent bariatric surgery at our accredited center. Among them, 84 patients (5%) qualified for this study. All cases were performed laparoscopically by two surgeons. Conversion to open surgery was 0%. There were no deaths.

Of the 84 patients who qualified for this study, 43 presented for WR (52.4%) and 41 presented for RC (47.6%). The most common primary procedure was gastric band (33/84, 39.9%), followed by gastric bypass (31/84, 36.9%), sleeve gastrectomy (17/84, 20.2%), and vertical banded gastroplasty (3/84, 3.6%). The range of primary and revisional procedures is displayed in Fig. 2. Sixty-nine patients (82.1%) were referred from outside our center, and 13 (15.5%) had more than one previous bariatric surgery.

Demographic information is displayed in Table 1. Mean BMI on presentation was 42 for WR and 38 for RC ( $p < 0.01$ ). Mean time to revision from index procedure was 6 years for WR and 5 years for RC ( $p < 0.01$ ). The median interval between their primary and revisional procedures was 6.8 years for WR and 5.1 years for RC. Mean operative time was 175.5 min for WR and 133 min for RC ( $p < 0.01$ ). Median length of stay was 2 days for both procedures.

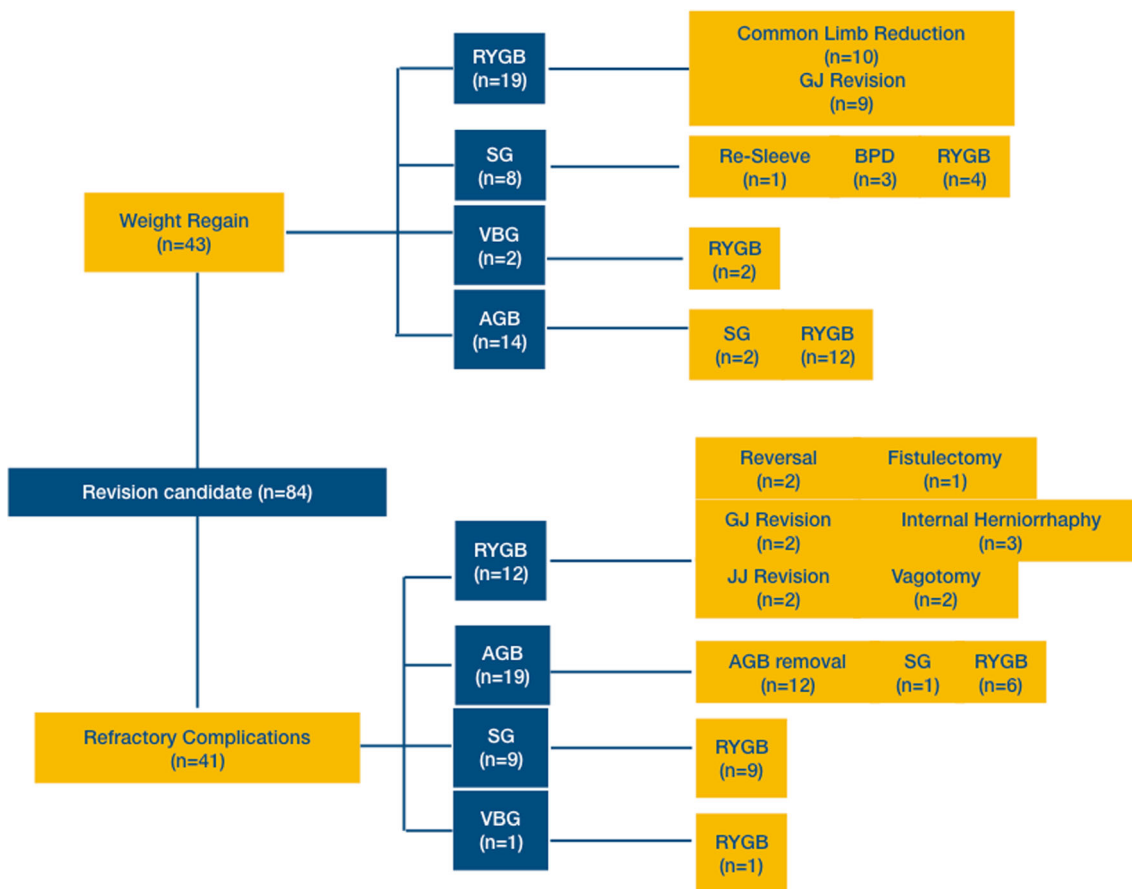


Fig. 2 Revision procedures

### Excess Weight Loss Following Revisional Surgery for WR

Forty-three patients presented for revision due to WR. Of the 24 patients with restrictive primary procedures, 21 underwent conversion to a malabsorptive procedure. Of the remainder, one opted for a repeat sleeve and the other a removal of their gastric band alone. Three- and twelve-month follow-up were 100 and 74.4%, respectively.

Table 2 displays weight loss outcomes for revisional surgeries performed for WR at 3-, 6-, 9-, and 12-month intervals. Patients presenting for WR following restrictive primary surgeries who presented with both WR and reflux symptoms ( $N = 18$ ) underwent conversion to RYGB or biliopancreatic diversion with duodenal switch; these patients experienced dramatic %EWL at 3 months (50–65.3%) that was sustained at 12 months postoperatively (50.1–79.1%). Three patients (one primary SG and two primary AGB underwent revisional

Table 1 Perioperative demographics

	Weight regain ( $n = 43$ )	Refractory complications ( $n = 41$ )	All ( $n = 84$ )
Age (years)	47.5	49.5	48.5
% female	75	87.5	81
% White	84.1	87.5	85.7
Years since primary	6.8	5.1	6.2
Pre-revisional BMI ( $\text{kg}/\text{m}^2$ )	45.3	37.3	41.5
Operative time (minutes)	175.5	133.0	154.6
Length of stay (days; range)	2 (2–6)	2 (1–5)	2

**Table 2** Revisional outcomes by procedure for weight regain

Primary revision	Pre-revision Number	3 months			6 months			9 months			12 months										
		Number	ΔBMI	% EBM	Number	ΔBMI	% EBM	Number	ΔBMI	% EBM	Number	ΔBMI	% EBM								
AGB	12	42.5	-8.6	47.4	50.3	17.7	10/12	-11.3	63.2	63.0	23.6	10/12	-12.7	71.3	73.1	27	8/12	-13.1	74.2	79.1	30.2
SG	2	52	-7.0	38.9	39	17.7	1/2	-9.4	22.2	26.5	13	1/2	-9.3	26.4	26.2	12.7	2/2	-9.0	24.4	28.3	13.9
SG	3	65.7	-19.7	51.8	52	9	3/3	-23.4	44.4	55.9	18.5	3/3	-25.2	41.2	51.4	22.2	3/3	-27.4	66.1	50.1	26.7
RYGB	4	42.3	-12.8	75.1	65.3	12.5	4/4	-12.3	75.0	62.5	17.1	4/4	-12.3	72.1	67.3	16.1	3/4	-12.3	73.6	72.2	16.5
Re-sleeve	1	46	-11	52.4	47.6	4.9	1/1	-11.0	52.4	47.6	7.3	1/1	-11.1	50.0	43.6	7.7	1/1	-11.1	52.9	43.6	7.7
VBG	2	40.5	-8.0	51.9	50.0	13.7	1/2	-9.7	62	57.8	14.5	2/2	-9.5	56.0	60.0	14	2/2	-6.5	54.4	59.3	13.5
RYGB Common limb reduction	10	45.5	-8.0	36.7	37.5	8.9	5/10	-7.0	49.7	52.2	16.1	7/10	-7.2	63.2	66.6	20.4	7/10	-5.1	54	54.7	20.1
GJ redo	9	43.2	-6.3	35.9	36.6	12.3	9/9	-7.7	41.9	34.6	16.7	7/9	-8.3	40.3	34.6	14.8	6/9	-7.3	35.9	31.5	15.6

BMI body mass index; %EWL percent excess weight loss; %EBMI percent excess BMI; %TWL percent total weight loss; AGB adjustable gastric band; RYGB Roux-en-Y gastric bypass; LOA lysis of adhesions; SG sleeve gastrectomy; BPD biliopancreatic diversion; VBG vertical banded gastroplasty

SG with a smaller but also stable improvement in weight parameters.

Nineteen patients presented with WR following RYGB. Nine had diagnostic findings showing a gastric pouch longer than 6 cm, non-excluded fundus, or stoma > 3 cm in diameter. These patients underwent resection and reconstruction of the pouch and proximal anastomosis as well as resection of gastro-gastric fistulae when present. The remaining 10 patients who had no abnormality of their gastric pouch or gastrojejunostomy underwent conversion to a distal bypass with common limb reduction to 200 cm. Three-month % EWL following proximal and distal revision was 36.6 and 37.5%, respectively; however, the effect was more robust for distal revisions at 12 months after surgery (31.5 and 54.7%, respectively).

**Complications**

As shown in Table 3, overall early and late complication rates were 3.6 and 10.7%, respectively. Major complications occurred in only 5% of patients. Patients experiencing any complication following revision for WR or RC are described in detail in Tables 4 and 5, respectively. There was only one leak, which was managed with percutaneous drainage and parenteral nutrition. Reoperation was required for 4 patients (4.7%, three WR and one RC); these were also the only four patients who required inpatient readmission following revision.

Of the 65 patients who were revised to a RYGB, early and late complications were 3.1 and 12.3%, respectively. Seven (10.8%) were minor while there were three (4.6%) major complications requiring reoperation; the small number of revisions to SG in our experience (n = 3) precluded analysis of this group.

**Discussion**

With consecutive yearly increases in surgical volume [2], primary bariatric patients are a rapidly growing cohort who will require long-term management of their weight, complications related to their post-surgical anatomy, or both. Revisional surgery is often the final option when other treatment modalities fail.

Variable indications and the need for individualized care that revisional surgery demands create a heterogeneous pool

**Table 3** Overall complications

	Minor	Major	Total (%)
Early (≤ 30 days)	1	2	3 (3.6%)
Late (> 30 days)	6	3	9 (10.7%)
Total (%)	7 (8.3%)	5 (6.0%)	12 (14.3%)

**Table 4** Complications following revision for weight regain

Revision procedure	Type	Complication	Management	Readmission	Outcome
AGB conversion to SG	Early	Incarcerated ventral hernia	Laparoscopic repair	Yes	Resolution
Gastrojejunostomy revision	Early	Anastomotic leak	TPN, drainage	Yes	Resolution
AGB conversion to RYGB	Late	Stricture	Endoscopic dilation	No	Resolution
AGB conversion to RYGB	Late	Marginal ulcer	PPI	No	Resolution
Gastrojejunostomy revision	Late	Recurrent intussusception	Diagnostic laparoscopy	Yes	Resolution

AGB adjustable gastric band; SG sleeve gastrectomy; *Early* < 30 days postoperatively; *Late* > 30 days postoperatively; TPN total parenteral nutrition

of patients and procedures [11]. In turn, postoperative outcomes of safety and efficacy are difficult to predict. The aim of our study was to present our two-surgeon, single-center experience and outcomes with laparoscopic revisional bariatric surgery.

Revisional outcomes in the prevailing literature are commonly characterized according to the second, rather than index, surgery. Brethauer's 2014 review of revisional bariatric surgery studies from 2004 to 2013 reported overall complication rates of 8.6–33% following conversion to RYGB and 7.1–18% following conversion to SG [6]. Additional single-center studies published in the interim report early complication rates of 8.7–22.2% [7, 11–13] after conversion to RYGB. While encouraging, morbidity following revisional surgery remains well above that seen after primary SG and RYGB [14]. Weight loss following revision for WR is difficult to standardize and varies considerably, but can approximate ranges expected for primary bariatric surgery depending on patient and perioperative factors [6, 15–17].

Our observed complication rates and length of stay are lower than most reported studies but within ranges observed by high volume centers referenced above. Additionally, the weight loss observed in our patients at 12 months after revision is within expected ranges following primary procedures [6, 15], with the exception of nine patients undergoing gastric pouch and/or gastrojejunostomy revision and two patients converted from AGB to SG. We believe that these results reflect careful patient selection, education, and preoperative

workup. Our operative times are longer than those reported in the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (100 min for revisional SG, 147 min for revisional RYGB, 14). While direct comparison between surgical techniques and perioperative outcomes are difficult to randomize, our results as well as those of the prevailing literature underscore the importance of maintaining a laparoscopic approach and meticulous dissection.

Our study is limited in its retrospective nature, lack of risk stratification, and the heterogeneity of indications and treatments inherent to the study of revisional bariatric procedures. Furthermore, with a follow-up of only 12 months, it is difficult to extrapolate long-term comorbidity resolution and weight loss, as well as the incidence of complications arising from the revisional surgeries themselves. While we did witness interval improvement in all weight loss parameters in all of our patients, this cannot be used to draw conclusions about the long-term expected weight loss following revisional bariatric surgery without additional longitudinal study.

## Conclusion

Patients presenting to our center for revisional surgery do so for either WR or RC, most commonly following gastric banding. Revisional bariatric surgery can be performed with low complication rates and with acceptable 12-month weight loss, though not with the same safety as primary procedures.

**Table 5** Complications following revision for refractory complications

Revision procedure	Type	Complication	Management	Readmission	Outcome
Jejunojunostomy redo	Early	Pain	Diagnostic laparoscopy	Yes	Resolution
Excision of gastro-gastric fistula	Late	Gastrojejunostomy stricture	Endoscopic dilation	No	Resolution
AGB conversion to RYGB	Late	Marginal ulcer	PPI	No	Resolution
AGB conversion to RYGB	Late	Indolent upper GI bleed	Diagnostic laparoscopy	No	Resolution
AGB removal	Late	Incisional hernia	Laparoscopic repair	No	Resolution
VBG conversion to RYGB	Late	Wound hematoma	Incision and drainage	No	Resolution
Closure of chronic internal hernia	Late	Wound dehiscence	Topical silver nitrate	No	Resolution

AGB adjustable gastric band; SG sleeve gastrectomy; *Early* < 30 days postoperatively; *Late* > 30 days postoperatively; TPN total parenteral nutrition; VBG vertical banded gastroplasty; PPI proton pump inhibitor

## Compliance with Ethical Standards

**Conflicts of Interest** The authors declare that they have no conflicts of interest.

**Ethical Approval Statement** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this retrospective study, formal consent is not required.

**Informed Consent Statement** As this study involved a retrospective review of a prospectively maintained, de-identified database, obtaining informed consent did not apply, and we obtained an exemption from informed consent by our center's Institutional Review Board.

**Statement of Human and Animal Rights** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this retrospective study, formal consent is not required.

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