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ORIGINAL ARTICLE

Revisional surgery after removal of eroded adjustable gastric bands

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KEYWORDS
Adjustable gastric band;
Complication;
Revisional surgery;
Sleeve gastrectomy

Summary *Background:* The aim of the study is to present surgical techniques and treatment outcomes for re-banding and sleeve gastrectomy as a revisional surgery after removing eroded adjustable gastric bands.
Methods: A retrospective analysis was performed to study laparoscopic re-banding or sleeve gastrectomy as revisional surgery for band erosion. Main outcome measures were success of therapeutic strategies, morbidity, body mass index, and percentage total excess weight loss before and after revision.
Results: From March 2013 to June 2017, a total of 11 patients underwent the revisional surgery. Six patients underwent sleeve gastrectomy at median 15.7 months (13.2–73.3 months) after band removal, and 5 patients gastric re-banding at median 5.4 months (3.1–43.8 months). One of the six patients that underwent sleeve gastrectomy was diagnosed to have a minor leak. No other critical postoperative complication was observed in each group. Median BMI at revision in the sleeve gastrectomy group was 32.7 kg/m^2 (31.2–40.8 kg/m^2). Median follow-up after revision was 33.8 months (15.5–63.7 months), and at last follow-up, median BMI was 26.4 kg/m^2 (23.6–34.6 kg/m^2), and median %TWL was 17.6% (9.5–31.5%). In the re-banding group, median BMI at revision was 30.7 kg/m^2 (27.0–41.4 kg/m^2). Median follow-up after revision was 25.5 months (13.5–45.4 months), and at last follow-up, median BMI was 23.5 kg/m^2 (22.0–30.1 kg/m^2) and median %TWL was 23.9% (9.1–29.0%).
Conclusion: Given the surgical techniques adopted, both re-banding and sleeve gastrectomy were found to be safe and effective revisional surgery after removal of eroded gastric band.

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1. Introduction

Band erosion (BE), together with slippage, superior pouch dilatation, and esophageal dilatation, is known to be one of the major complications after laparoscopic adjustable gastric band (LAGB). The frequency of BE found in mid-term observational studies ranges from 0.5 to 11.1%,[1] but due to limited patient numbers, accurate data based on long-term follow-up are scarce. Himpens and colleagues[2] observed 82 patients treated using a perigastric technique with a gastric band for more than 12 years, and reported BE in 28% of cases, whereas in more recent studies with a 14-years observation period, only 3% of cases showed BE.[3,4]

A number of patients, request only band removal without revisional surgery. However, after removal of eroded band, most patients will gain weight and these patients will require another bariatric operation. As a revisional surgery after BE, reinsertion of gastric band (re-banding),[5,6] sleeve gastrectomy (SG),[7–9] and Roux-en-Y gastric bypass (RYGBP)[10] have been reported although details of surgical techniques and patients follow-up have not been described. Early results of revisional surgery for weight gain after removal of eroded gastric band at our hospital were published in 2012 and 2014.[8,11] At that time the incidence of postoperative complications (e.g., leakage, stenosis, and re-erosion) was significant, which was due to technical difficulty caused by fibrosis and scar formation from inflammation of surrounding gastric wall accompanying BE.

In the present retrospective study, we present our updated surgical techniques and examine the outcomes of rebanding or revisional SG in patients that experienced weight regain after band removal due to BE.

2. Materials and methods

This retrospective study was performed to investigate the efficacies of second-stage rebanding and SG in patients with BE who experienced significant weight gain after band removal. The patients recruited underwent the revisional surgery between March 2013 and June 2017. Type of revisional surgery was determined by patient preference unless there is absolute contraindication. Revisional surgery was performed according to BMI (Body Mass Index) as described at the Asian Consensus Meeting on Metabolic Surgery (ACMOM 2008, Trivandrum, India). Patients with significant weight gain after band removal who requested revision were also included, despite a BMI below the reference level. Written informed consent for revision was obtained from each patient. The local ethical committee approved the study (GDIRB2018-281).

All revisional surgeries were performed in two stages, that is, were performed at least 3 months after band removal, to allow sufficient time for the healing of chronic inflammation due to BE. The patients who have severe esophagitis or hiatal hernia on endoscopy and esophagogram were excluded from revisional surgery. Preoperative antibiotics and low molecular weight heparin were injected subcutaneously to prevent deep vein thrombosis. Patients were maintained in supine and reverse Trendelenburg positions. Previous laparoscopic scars were used during all revisions. Surgery involved adhesiolysis between the corner of the left lobe of the liver and stomach wall using blunt and sharp dissection. During the procedure, the left gastric artery and its major branch arteries were protected from damage for bloodless surgical field. In cases of firm adhesions between the left lobe of the liver and the cardia, the left lobe of the liver was separated using an endoscopic GI stapler. A non-absorbable suture (2-0 PBT non-absorbable; V-Loc™, Covidien, Norwalk, CT) was used for repair of hiatal defect.

During rebanding, the possibility of gastric perforation was minimized by constructing a posterior tunneling at 1–2 cm above the scar tissue around the previous band. When an endoscopic suction device was used to aid in the dissection of pars flaccida, the outline of the posterior wall of cardia was clearly visible and passage of band passer was much easier. The left hiatus fascia was provided with a small incision rather than pushing with band passer due to firm fibrosis, to enable tunneling of posterior stomach wall passage to be safely completed. Gastrogastric sutures for fixing the band were placed. An intraoperative upper GI endoscopy was used to observe the area of the surgical site to confirm no small perforation was present inside the stomach wall (Fig. 1).

Revisional SG was also performed using previous laparoscopic scars. Additional two 10 mm incisions were made along the mid-point of the clavicle in the left and right lower abdomen for introducing endoscopic stapling devices. A 36-Fr Bougie was inserted along the lesser curvature. Gastrolysis started from the greater curvature 6 cm proximal to the pylorus toward the His angle. Sleeve gastrectomy was performed using approximately 5–7 Green cartridges (4.8-mm staple height) through a 60-mm-long GI stapler along the Bougie. The use of the last one or two stapling avoided the fibrous area of the preexisting eroded gastric band. Inverting this part of sleeve was carried out with the use of a non-absorbable suture (2-0 PBT non-absorbable; V-Loc™, Covidien, Norwalk, CT) for prevent 'dog-ear' formation. Lembert suture reinforcement with absorbable sutures (2-0 absorbable, V-Loc, Covidien, Norwalk, CT) was performed using a running seromuscular bites imbricating the remaining staple-line under minimal tension (Fig. 2). A Closed suction drainage system was used along the resection margin.

For those that underwent rebanding, a liquid diet was recommended for one week from one day after surgery. Band adjustment was first initiated 6–8 weeks after surgery. Patients that underwent revision SG were allowed to start drinking the day after surgery and recommended to take a liquid diet for 15 days followed by a soft diet for 15 days and then a normal diet from one month after surgery. Oral PPI (proton pump inhibitor) antacid was prescribed for about three months after surgery. Patients were asked to return to the outpatient clinic one week and three, six, and twelve months after surgery, and annually thereafter. The age, sex, body weight, BMI at initial band placement, time from initial gastric band insertion to removal (months), BMI and percentage of total weight loss (%TWL) at time of band removal were analyzed. Postoperatively, type of revisional surgery, time from band removal to revisional surgery (months), BMI at revision, and postoperative complications were analyzed. Follow-up after revisional surgery (months), body weight, BMI, and %TWL at the last observation were

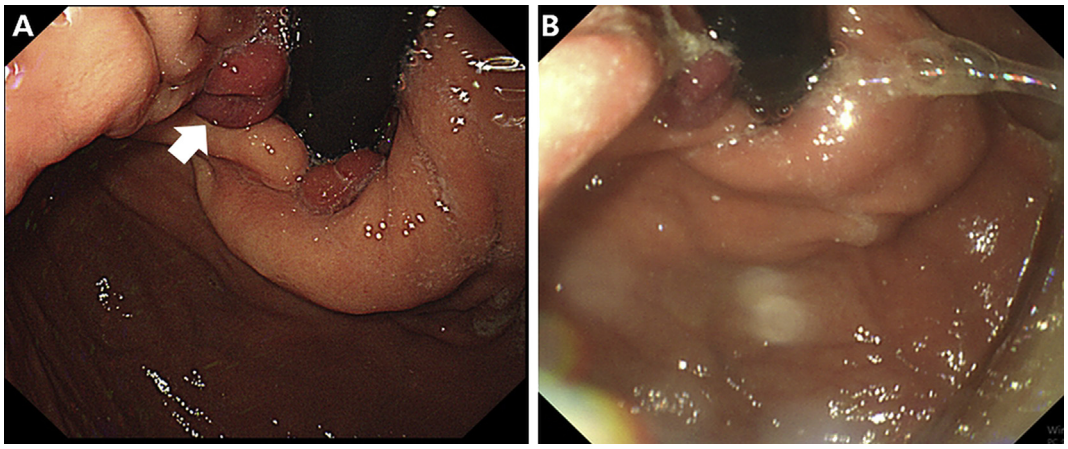

Fig. 1 Endoscopy before (A) and after (B) re-banding. There observed a healed fistula from previous BE (arrow). Gastric perforation was not observed on intraoperative endoscopy.

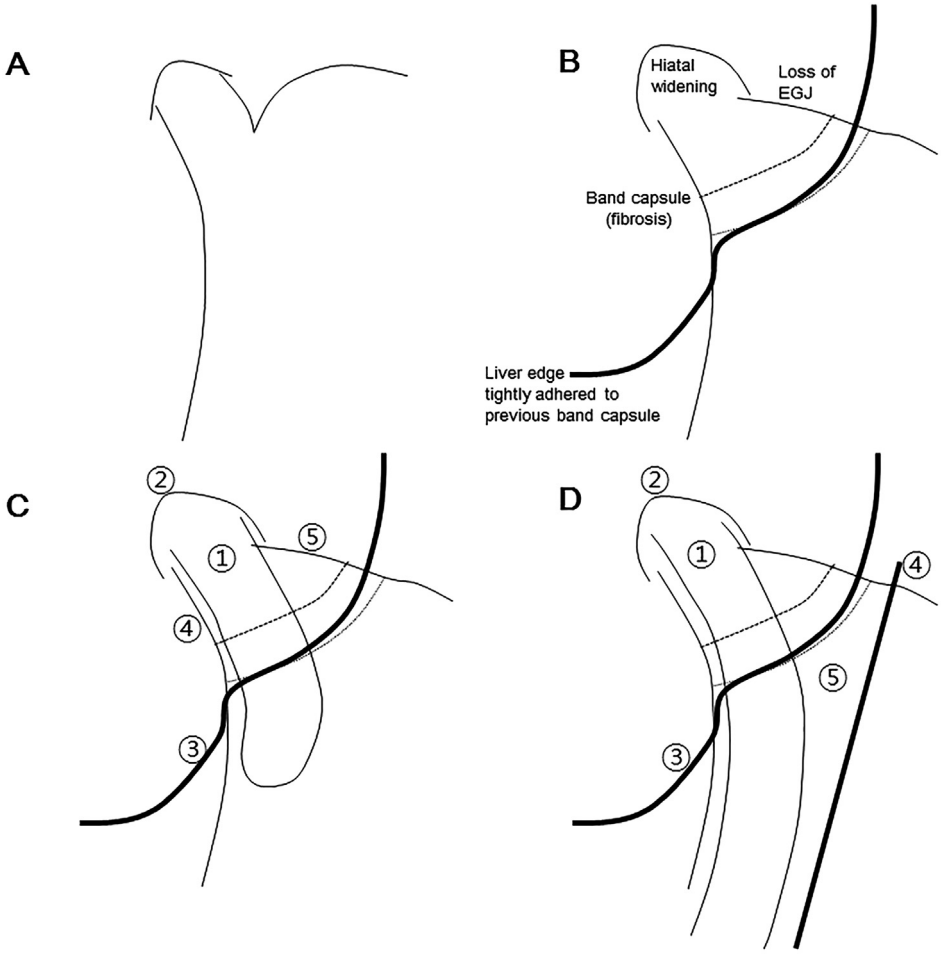

Fig. 2 A: Normal anatomy of cardia. B: Anatomic changes of cardia after removal of an eroded adjustable gastric band. C: Technical points of rebanding (① Use of 36 Fr Bougie ②, ③ Repair of hiatal widening after releasing liver edge from cardia, ④, ⑤ A band passer should be placed under crus fascia, 1—2 cm above the previous band location). D: Technical points of SG after BE (① Use of 36 Fr Bougie, ②, ③ Repair of hiatal widening after releasing liver edge from cardia, ④ Final stapling away from the fibrotic band capsule, ⑤ Plication of redundant fundus by imbricating the staple line widely).

also analyzed. In addition, we analyzed the results of questionnaires about the outcome of QoL and satisfaction between rebanding and SG, especially gastroesophageal reflux (GER) and usage of PPI.

3. Results

From March 2013 to June 2017, a total of 11 patients (10 women and one man) underwent the revisional surgery for significant weight gain. This cohort of patients was part of the 39 patients who underwent band removal due to BE among the 267 patients who underwent primary gastric banding surgery in our hospital. Median patient age at time of initial gastric band surgery was 35 years (30—59 years). Median BMI at initial gastric band surgery was 33.6 kg/m^2 (29.9—45.2 kg/m^2), and median time to band removal after insertion was 46.1 months (9.5—95.4 months). At time of band removal, median body weight was 67.1 kg (52.0—81.6 kg), median BMI was 24.6 kg/m^2 (19.4—29.0 kg/m^2), and median %TWL was 25.5% (17.1—45.7%) (Table 1).

Six patients underwent revisional SG at median 15.7 months (13.2—73.3 months) after band removal, and 5 patients rebanding at median 5.4 months (3.1—43.8 months). Median time required for the procedures were 170 min (150—190 min) and 100 min (100—120 min), respectively. Median volume of blood loss during revision were 400 cc (100—800 cc) and 30 cc (20—400 cc), respectively. There was no case of open conversion. One of the six patients that underwent SG was re-admitted to our hospital with abdominal pain three days after discharge. A minor leak was suspected by CT scan, and the patient was discharged after 3 days of conservative treatment. No other critical postoperative complication was observed in each group.

Median body weight and BMI at revision in the SG group was 90.4 kg (76.0—114.7 kg) and 32.7 kg/m^2 (31.2 kg/m^2—40.8 kg/m^2). Median follow-up after revision was 33.8 months (15.5—63.7 months), and at last follow-up, median body weight was 71.7 kg (57.4—97.3 kg), median BMI was 26.4 kg/m^2 (23.6 kg/m^2—34.6 kg/m^2), and median %TWL was 17.6% (9.5%—31.5%). In the rebanding group, median body weight and BMI at revision was 79.3 kg (72.3—110.0 kg) and 30.7 kg/m^2 (27.0 kg/m^2—41.4 kg/m^2). Median follow-up after revision was 25.5 months (13.5—45.4 months), and at last follow-up, median body weight was 63.0 kg (56.3—80.0 kg), median BMI was 23.5 kg/m^2 (22.0 kg/m^2—30.1 kg/m^2) and median %TWL was 23.9% (9.1—29.0 kg) (Table 1).

At last follow-up, in SG group, median total score for GER was 0.5 (0—3.0), and median total score for BAROS was 4.55 (0.55—6.25). Three patients (50%) achieved "very good" results, however, one patient (16.7%) only achieved "failure" due to insufficient weight loss, complication (leak), low QoL score, and unchanged comorbidity (hypertension). In rebanding group, median total score for GER was 1.0 (1.0—2.0), and median total score for BAROS was 5.75 (2.50—6.50). Three patients (60%) achieved "very good" results, and there was not any patient with "failure" (Table 2).

4. Discussion

After removing a gastric band due to BE, maintenance of reduced body weight by diet or/and exercise is always preferred. However, in practice revisional surgery is occasionally required. BE makes the cardia more complex and vulnerable during further interventions,[12] which makes revisional surgery after band removal technically demanding. Therefore there should be sufficient discussion of appropriate revisional operation for patients with BE. Biliopancreatic diversion (BPD) is known to be the most effective and safe procedure, as its proximal anastomosis is at the duodenum, away from the gastric band scar tissue[13] but seems to be rather aggressive for young women of child bearing age, who constitute majority of the patients having gastric band in our country. We consider RYGBP the next best thing, but operative approach is not easily accessed in the lesser curvature associated with BE. Suter and colleagues[10] in their laparotomic conversion series described as follows "This step of the procedure was very difficult and tedious, because of the intense inflammatory reaction accompanying BE." In our point of view, RYGBP after BE has potential problems, such as, a large gastric pouch, which may cause insufficient weight loss or marginal ulcer.

Most recent comparative study of post-LAGB conversion has shown similar results, reporting no significant differences in EWL, BMI change, and complication following SG or RYGBP.[14—16] There have been reports of serious complications like leakage even after SG after BE.[8,17,18] However, as shown in the present study, SG produces excellent results in terms of weight loss and safety when technique principles we have described are followed. In six patients undergoing revisional SG, after median follow-up after LSG of 33.8 months (15.5—63.7 months), median %TWL was 17.6% (9.5%—31.5%). One patient was re-admitted to our hospital with a minor leak along the staple line, which was treated by conservative treatment. No other critical postoperative complication was observed.

Rebanding provides another revision option. Abu-Abeid and colleagues[5] reported that 16 patients, at the early stage of the BE, underwent concurrent band removal and the re-insertion, and re-operation was not required during the follow-up period of 28 months. Niville and colleagues[6] also reported no case of repeat BE in 10 patients who underwent band reinsertion during 48 months. On the other hand, Chisholm and colleagues[19] observed 29 patients who underwent gastric band reinsertion, and found re-erosion in five patients (17%) during 23 months follow-up (14—34 months). Many patients who undergo band removal due to BE are less likely to have compliance with the band (repeated vomiting from over-inflation of band), and therefore, band reinsertion and post-op care in these patients should be performed with caution. In the five patients in this study, after re-banding, median follow-up was 25.5 months (13.5—45.4 months), and their median %TWL was 23.9% (9.1—29.0%). No patient showed re-erosion in endoscopic surveillance, which supports the results of previous studies.[5,6] Thus, when re-banding was performed according to the principles of technique we have described, weight loss and patient satisfaction were higher than expected. As far as reflux issue and QoL results are concerned, at last follow-up, in SG group, median total score for GER was 0.5 (0—3.0), and median total score for BAROS was 4.55 (0.55—6.25). Three patients (50%) achieved "very good" results, however, one patient (16.7%) only achieved "failure". In re-banding group, median total score for GER

Table 1 Demographic & anthropometric data of the patients at AGB implantation, explantation, revision, and follow-up.

	Sex	Age (y)	*At AGB implantation*				Interval[a] (mo)	*At RGB*				
			Bwt (kg)	BMI (kg/m^2)	CM	Band		Bwt (kg)	BMI (kg/m^2)	TWL (%)	CM	Approach for RGB
1	M	53	104.6	37.2	HiBP	SAGB	9.5	81.6	29.0	22.0	–	Lap-extra
2	F	30	92.8	34.9	–	APS	14.4	69.1	26.0	25.5	–	Lap-extra
3	F	33	76.0	31.2	–	9.75	30.4	57.9	23.8	23.8	–	Lap-extra
4	F	31	116.8	43.4	–	10.0	32.3	69.9	26.0	40.1	–	Endoscopy
5	F	39	91.7	32.0	–	APS	69.3	70.6	24.6	23.0	–	Endoscopy
6	F	38	85.0	33.2	DM	9.75	62.6	57.6	22.5	32.2	–	Lap-trans
Median		**35.5**	**92.3**	**34.1**			**31.4**	**69.5**	**25.3**	**24.7**		
Min		**30.0**	**76.0**	**31.2**			**9.5**	**57.6**	**22.5**	**22.0**		
Max		**53.0**	**116.8**	**43.4**			**69.3**	**81.6**	**29.0**	**40.1**		
7	F	31	85.0	33.2	–	APS	46.1	53.2	20.8	37.4	–	Endoscopy
8	F	35	90.0	33.6	–	9.75	91.4	52.0	19.4	42.2	–	Lap-trans
9	F	40	89.7	36.7	–	9.75	95.4	67.2	27.5	25.1	–	Lap-extra
10	F	59	120.0	45.2	DM	APS	19.1	65.1	24.5	45.7	–	Endoscopy
11	F	32	81.0	29.9	–	9.75	47.1	67.1	24.8	17.1	–	Endoscopy
Median		**35.0**	**89.7**	**33.6**			**47.1**	**65.1**	**24.5**	**37.4**		
Min		**31.0**	**81.0**	**29.9**			**19.1**	**52.0**	**19.4**	**17.1**		
Max		**59.0**	**120.0**	**45.2**			**95.4**	**67.2**	**27.5**	**45.7**		
P[e]		**0.006**	**0.647**	**0.927**			**0.201**	**0.100**	**0.360**	**0.361**		

	Sex	Age (y)	Time after RGB (mo)	*At Revision (LSG or Re-AGB)*						F/U (mo)	*At last follow-up*			
				op	Bwt (kg)	BMI (kg/m^2)	CM	OR time (min)	Blood loss (ml)	Cx		Bwt (kg)	BMI (kg/m^2)	TWL (%)	CM
1	M	53	73.3	LSG	114.7	40.8	HiBP	180	500	Leak	15.5	97.3	34.6	15.2	HiBP
2	F	30	15.6	LSG	86.0	32.4	–	160	300	–	57.2	77.8	29.3	9.5	–
3	F	33	13.2	LSG	76.0	31.2	–	150	300[b]	–	63.7	57.4	23.6	24.4	–
4	F	31	15.7	LSG	95.0	35.3	–	190	500[b]	–	48.1	65.1	24.2	31.5	–
5	F	39	19.2	LSG	94.7	33.0	–	150	800[b]	–	19.5	78.3	27.3	17.3	–
6	F	38	14.2	LSG	79.8	31.2	DM	180	100	–	16.6	65.5	25.6	17.9	–
Median		**35.5**	**15.7**		**90.4**	**32.7**		**170**	**400**		**33.8**	**71.7**	**26.4**	**17.6**	
Min		**30.0**	**13.2**		**76.0**	**31.2**		**150**	**100**		**15.5**	**57.4**	**23.6**	**9.5**	
Max		**53.0**	**73.3**		**114.7**	**40.8**		**190**	**800**		**63.7**	**97.3**	**34.6**	**31.5**	
7	F	31	5.4	Re-AGB[c]	79.3	31.0	–	100	400	–	40.1	56.3	22.0	29.0	–
8	F	35	3.1	Re-AGB[d]	72.3	27.0	–	120	30	–	13.5	63.0	23.5	12.9	–
9	F	40	10.0	Re-AGB[d]	75.0	30.7	–	100	100	–	14.7	68.2	27.9	9.1	–
10	F	59	43.8	Re-AGB[c]	110.0	41.4	DM	100	30	–	25.5	80.0	30.1	27.3	–
11	F	32	4.0	Re-AGB[d]	81.4	30.1	–	120	20	–	45.4	62.0	22.9	23.9	–
Median		**35.0**	**5.4**		**79.3**	**30.7**		**100**	**30**		**25.5**	**63.0**	**23.5**	**23.9**	
Min		**31.0**	**3.1**		**72.3**	**27.0**		**100**	**20**		**13.5**	**56.3**	**22.0**	**9.1**	
Max		**59.0**	**43.8**		**110.0**	**41.4**		**120**	**400**		**45.4**	**80.0**	**30.1**	**29.0**	
P[e]		**0.006**	**0.068**		**0.201**	**0.100**		**0.005**	**0.034**		**0.273**	**0.361**	**0.273**	**1.000**	

AGB = Adjustable Gastric Band, RGB = Removal of gastric band, LSG = Laparoscopic Sleeve Gastrectomy, Re-AGB = Reinsertion of adjustable gastric band, Bwt = Body Weight, BMI = Body Mass Index, CM = comorbidity, TWL = Total Weight Loss, op = operation (revision) name, Cx = Complication, HiBP = Hypertension, SAGB = Swedish Adjustable Gastric Band, Lap-extra = Laparoscopic Extragastric Approach, APS = Lap-Band APS®, 9.75 = Lap-band 9.75®, 10.0 = Lap-band 10.0®, Endoscopy = Endoscopic Approach, DM = Diabetes Mellitus, Lap-trans = Laparoscopic Transgastric Approach (Short gastrotomy + division of intraluminal band).

[a] Time from initial band placement to band removal (mo = month).

[b] Transfusion of Packed RBC.

[c] Midband™ (MIDBAND, Medical Innovation Development, Villeurbanne, France).

[d] LAP-BAND® APS.

[e] Two-tailed, Mann–Whitney U test.

Table 2 Scoring for reflux symptoms evaluation and BAROS.

	Scoring for GER[a]				BAROS[b]		
	Heartburn	Reflux	Vomit	Total score	QoL score	Total score	Outcome group
1	1	0	0	1	−0.25	0.55	Failure
2	0	0	0	0	1.00	3.00	Fair
3	0	0	0	0	1.25	5.05	Very good
4	1	1	1	3	1.25	5.05	Very good
5	0	0	0	0	1.25	4.05	Good
6	1	1	0	2	2.25	6.25	Very good
Median	**0.5**	**0.0**	**0.0**	**0.5**	**1.25**	**4.55**	
Min	**0.0**	**0.0**	**0.0**	**0.0**	**−0.25**	**0.55**	
Max	**1.0**	**1.0**	**1.0**	**3.0**	**2.25**	**6.25**	
7	1	1	0	2	2.50	6.50	Very good
8	0	1	0	1	1.00	4.00	Good
9	0	1	0	1	1.50	2.50	Fair
10	0	1	0	1	0.75	5.75	Very good
11	0	1	1	2	2.50	6.50	Very good
Median	**0.0**	**1.0**	**0.0**	**1.0**	**1.50**	**5.75**	
Min	**0.0**	**1.0**	**0.0**	**1.0**	**0.75**	**2.50**	
Max	**1.0**	**1.0**	**1.0**	**2.0**	**2.50**	**6.50**	
P[c]	**0.326**	**0.029**	**0.892**	**0.391**	**0.405**	**0.359**	

[a] Scoring system for reflux symptom[22]: Heartburn = 0: no symptoms, 1: <2 episodes per week, 2: >2 episodes + PPIs (proton pump inhibitors), 3: esophagitis grade > II (LA classification), 4: complications (stenosis, ulcer, Barrett's). Reflux = 0: no symptoms, 1: <2 episodes per week, 2: >2 episodes per week, no medication, 3: >2 episodes per week + medications (i.e., prokinetics). Vomit = 0: no symptoms, 1: <2 episodes per week, 2: >2 episodes per week.
[b] BAROS = Bariatric Analysis and Reporting Outcome System.[23]
[c] Two-tailed, Mann–Whitney U test.

was 1.0 (1.0–2.0), and median total score for BAROS was 5.75 (2.50–6.50). Three patients (60%) achieved "very good" results, and there was not any patient with "failure". In subgroup analysis of GER, heartburn was more prevalent symptom in SG, and reflux (non-acid) was more prevalent symptom in re-banding group. The former could be explained by the narrow gastric lumen and weakened LES (lower esophageal sphincter) pressure associated with sleeve resection. The latter could be explained by restrictive effect of the band itself. In both group, except one in SG group (insufficient weight loss, complication (leak), low QoL score (−0.25), and unchanged comorbidity (hypertension)), most patients achieved good results after revision of eroded gastric band. More long-term follow-up studies with larger number of patients are needed to assess whether this outcome is confirmed in large patient groups. The authors would like to emphasize some technical aspects of gastric band and sleeve gastrectomy as a revision after removal of band due to BE. The first concerns the treatment of adhesion after band removal due to BE. Adhesions of omentum and parietal peritoneum, which are observed when pneumoperitoneum is established, can be removed using an energy device without causing bleeding to provide a primary approach to the cardia. Adhesion between the left hepatic lobe and gastric cardia must be removed to allow the new band to be inserted into the correct position. In the case of revisional LSG after BE, it is not possible to determine whether there is a significant defect in the hiatus and there is a remained fundus at the top of the upper gastric sleeve unless this adhesion is properly treated. After band removal due to BE, this adhesion is strong and firm, and the dissection of this area may result in massive bleeding (liver capsule) or fistulas (stomach wall), which increase the likelihood of surgical complications. On the other hand, usually, there is a region without adhesion at more proximal area, so it is possible to remove this firm adhesion using Endo GI stapler (1–2 times) with minimal bleeding.

The second point involves gastric rebanding. When constructing the posterior gastric wall passage for new band, the possibility of perforating the posterior gastric wall can be minimized by forming a passage in upper portion of existing scar tissue. When an endoscopic suction device was used to aid in the dissection of pars flaccida, with the 36 Fr Bougie inserted in the stomach, the outline of the gastric posterior wall and the point where the right and left hiatus muscles met were visually well distinguished and the posterior gastric wall passage was much easier. The left hiatus fascia, which is the last part of the posterior gastric passage, is robust due to previous chronic inflammation and fibrosis accompanying BE, so that the posterior tunneling can be completed safely by sending out the incision on the fascia rather than pushing it with force. This is the site where the part of the fundus wall is attached to the diaphragm and perforation by the band passer can occur. The following method was used to determine whether the last part of the posterior gastric wall passage is a fibrous membrane that can make an incision or a fundus or distal esophagus that must never be performed using a passer. In the case of a fibrous membrane, pushing the passer shows a metallic sheen at the end of the passer and a

small ovoid hole for holding a band tubing located on the side of the passer is observed. Also, if the posterior tunneling was made correctly, the passer runs naturally without resistance when you turn the wrist holding the passer. The third point concerns treatment of the fundus at time of the revisional SG. The tissue underlying an eroded band is fibrous with a poor blood supply, and thus, if this area is stapled, the possibility of leakage increases. In this study, SG was performed using only a green cartridge, and stapling of the fibrotic cardia was avoided during resection of the upper part of stomach. At this time, the small fundus may remain in the upper part of the stomach (dog-ear pattern), and a non-absorbable suture was used to inverting staple line in this area.

We have a very high incidence of BE (14.6%, 39/267), which should be contributed to the small band. More than half of the patients in this study had Lap-band 9.75® or Lap-band 10.0®. BE now becomes less because of the application of larger band.[4]

The present study has several limitations. First, it is inherently limited by its retrospective design and the small number of patients enrolled without long term follow-up. Furthermore, although SG group had more blood loss and longer operation time, the results obtained failed to determine which of the two revisional procedures was more effective after band removal due to small number of patients and difference of the median follow-up time after revision in each group. Nevertheless, rebanding and revisional SG were both found to be safe and effective as the revisional surgery after BE. In this study, we did not include malabsorptive surgeries, such as, RYGBP or BPD. In general, there is controversy about the effect of another restrictive surgery after failed restrictive surgery.[20] It is our point of view that those who fail to lose weight without erosion or slippage can be defined as "intolerance" (a non-slippage and non-erosion long complication of adjustable gastric band). Recently, it has been reported that sleeve gastrectomy is the dominant procedure (43.6%) in our country followed by gastric bypass surgery.[21] The better outcomes achieved by sleeve gastrectomy in terms of weight loss and morbidity, have contributed to its popularity and accelerated the decline in gastric banding over recent years. For this reason, generally we do more and more revisional SGs (concurrent SG and band removal, or staged SG after band removal) for the patients having intolerance. In this study, however, method of revision was mainly determined by patient preference, which was influenced mainly by patients' experiences, such as, the amount of weight loss achieved by the first gastric band and symptoms during the erosion period. For example, patient #1 experienced relatively early erosion and severe peritonitis at the time of removal of the band, and therefore, was reluctant to choose rebanding, whereas patient #10 experienced achieved mid-term weight loss and antidiabetic effects, and thus, chose re-banding. Furthermore, because of its popularity, many patients with previous failed gastric banding tend to seek revision surgery for weight regain by SG rather than by RYGBP, because of the well-known long term complications associated with RYGBP. Further studies are definitely necessary about the relative indication/contraindication of revision after band removal due to BE. There are several points to note in this regard: patients BMI at revision, comorbidity, degree of esophagitis before revision, previous peritonitis, and method of band explantation. We think that the latter is important because revisional surgery was much easier in case of former endoscopic or trans-gastric removal of eroded gastric band. On the contrary, previous history of severe peritonitis associated the BE can be a contraindication for revision.

The median value of BMI at time of initial gastric band insertion in our 11 study subjects was 33.6 kg/m^2 (29.9—45.2 kg/m^2), and median BMI at reoperation in SG and re-banding group was 32.7 kg/m^2 (31.2 kg/m^2—40.8 kg/m^2) and 30.7 kg/m^2 (27.0 kg/m^2—41.4 kg/m^2), respectively. Thus, several did not meet the traditional indications for surgery. Therefore, it is doubtful whether weight loss or complication rate observed in this study can be universally applied to morbidly obese patients. In the early days of obesity surgery in Korea, there was a tendency to perform gastric band surgery in patients with a relatively low BMI, and gastric banding was performed mainly in local hospitals. These attitudes seem to influence the demographic characteristics of the patients studied.

This study shows that no major complications were observed immediately after revisional surgery, which suggests surgeon should go through a learning curve. There was no direct reference to the learning curve of reoperation performed on patients who had increased weight after removal of the gastric band due to BE. However, as compared with our previously published clinical observational studies, we encountered no significant complications, such as, re-erosion (after rebanding) or leakage or stenosis (after revisional SG) requiring further surgery, and weight loss was significantly improved after both surgeries, which suggests surgeon's experience had a clear impact on the revisional surgery after BE.

5. Conclusion

Given the advanced surgical techniques we adopted, both re-banding and SG were found to be safe and effective revisional surgery after removal of an eroded gastric band. More large number of patients with longer follow-up will draw a definite conclusion for this issue.

Competing interests

The authors declare that they have no competing interests.

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