becomes common, more patients are presenting to the emergency department with complications of the procedure, particularly those resulting from slippage of the gastric band [6, 7]. Because the consequences of slippage may require acute surgical intervention, it is imperative that the radiologist is familiar with the surgical technique to correctly position the band and the appearances of a gastric band when correctly and incorrectly positioned. The purpose of this article is to describe a sign on radiography for gastric band slippage, a complication of adjustable gastric banding surgery, and to emphasize the importance of this finding to radiologists and clinicians.

**OBJECTIVE.** The purpose of this article is to describe a sign on radiography for gastric band slippage, a complication of adjustable gastric banding surgery, and to emphasize the importance of this finding to radiologists and clinicians.

**MATERIALS AND METHODS.** We reviewed the radiologic findings in 55 consecutive patients who underwent laparoscopic gastric banding. Between January 2007 and September 2008, gastric band slippage was diagnosed in four patients at our institution. All patients underwent an upper gastrointestinal examination at the time of presentation. On the basis of either radiographic findings or clinical presentation, all patients underwent exploratory surgery.

**RESULTS.** In all four patients with surgically proven gastric band slippage, the initial abdominal radiograph showed an O-shaped configuration of the gastric band, which we have termed the “O” sign. Baseline upper gastrointestinal examinations were available for comparison in all patients. In each case, the O-shaped configuration of the band was a change from its rectangular appearance when in the proper position.

**CONCLUSION.** As laparoscopic adjustable gastric banding is increasingly used, more patients will present to the emergency department with complications of the procedure, particularly complications from band slippage. Because the consequences of slippage may require acute surgical intervention, it is imperative that the radiologist is familiar with the surgical technique to correctly position the band and the appearances of a gastric band when correctly and incorrectly positioned. Identification of the O sign on radiography can potentially aid the radiologist, surgeon, or emergency department physician in the early detection of gastric band slippage and appropriate patient triage.

**Keywords:** bariatric surgery complications, fluoroscopy, gastric band, gastric band slippage, LAGB, laparoscopic adjustable gastric band

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underwent the laparoscopic gastric banding procedure. The patients ranged in age from 22 to 64 years old. All patients underwent a single-contrast upper gastrointestinal (UGI) examination to assess the position of the gastric band and to exclude complications such as obstruction or leak. The UGI examination in all the patients included an initial scout abdominal image to document the position of the band. Each patient was asked to ingest a small amount of water-soluble contrast agent for fluoroscopy. At the discretion of the radiologist performing the examination and after exclusion of an obvious leak, some studies were repeated with thin barium to further delineate subtle findings. In six of the 55 patients, the UGI examination was performed after the patient presented to the emergency department with symptoms including nausea, vomiting, bloodtinged emesis, and abdominal pain. The remaining patients underwent a routine UGI examination on postoperative day 1 after placement of the laparoscopic adjustable gastric band.

Between January 2007 and September 2008, gastric band slippage was diagnosed in four patients at our institution. The time between preplacement of band are medial right diaphragmatic crus (thin arrow) and angle of His (thick arrow).

Surgical Device and Technique

The laparoscopic adjustable gastric band consists of a radiopaque silicone band lined with an inflatable inner cuff (white arrows) connected via tubing to an implantable subcutaneous injection port (black arrow).

Fig. 1—Laparoscopic adjustable gastric band consisting of silicone band lined with inflatable inner cuff (white arrow) connected via tubing to implantable subcutaneous injection port (black arrow).

A UGI examination is often used for the immediate postoperative evaluation of band placement. The initial abdominal scout image of the UGI examination is extremely valuable in the evaluation of whether the gastric band has been properly placed. The normal position of the gastric band on the anteroposterior projection has been described in terms of the phi angle: The phi angle normally ranges between 4° and 58° and is defined by the angle created between a vertical line drawn through the spinal column and a line drawn through the horizontal axis of the band [10]. In our experience, the ideal band position can be thought of as the hands of a clock with ends of band pointing toward the 2- and 8-o’clock positions.

Normal Postoperative Position of the Gastric Band

A UGI examination is often used for the immediate postoperative evaluation of band placement. The initial abdominal scout image of the UGI examination is extremely valuable in the evaluation of whether the gastric band has been properly placed. The normal position of the gastric band on the anteroposterior projection has been described in terms of the phi angle: The phi angle normally ranges between 4° and 58° and is defined by the angle created between a vertical line drawn through the spinal column and a line drawn through the horizontal axis of the band [10]. In our experience, the ideal band position can be thought of as the hands of a clock with the ends of band pointing toward the 2- and 8-o’clock positions (Fig. 3).

Gastric Band Slippage

Slippage of the gastric band is one of the relatively common and serious complications after placement of a laparoscopic adjustable gastric band and has been found in 4–13% of patients.
The O Sign to Diagnose Gastric Band Slippage

Band slippage denotes herniation of the distal stomach upward through the band, which may result in eccentric pouch enlargement, stomal stenosis, and possible obstruction [12, 13]. Mild cases of band slippage without obstruction can be treated conservatively by band deflation and observation. Severe band slippage can result in obstruction and is a surgical emergency. The timely diagnosis of gastric band slippage is essential to avoid fatal complications such as gastric volvulus, infarction, and perforation [3, 14].

**Results**

On the initial scout abdominal radiograph, all four patients with surgically proven gastric band slippage showed an O-shaped configuration of the gastric band, which we termed the “O” sign. The initial baseline postoperative UGI examination was available for comparison in all four patients. In all cases, the O configuration of the slipped gastric band seen on radiographs obtained at presentation was a change from its rectangular appearance when properly positioned—
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Fig. 6—26-year-old woman with laparoscopic adjustable gastric band placed 18 months earlier in Dominican Republic who presented after several days of nausea, vomiting, and mid epigastric pain.

A, Anteroposterior upright chest radiograph obtained months before presentation to surgeon’s office shows normal position of gastric band (arrow).

B, Compared with prior chest radiograph (A), anteroposterior abdominal scout image at time of presentation shows alteration in band position with O-shaped configuration, “O” sign. In surgeon’s office, fluid was aspirated from access port without relief of symptoms.

C, Coned-down lateral image of abdomen shows dilatation of pouch (short arrows) with small amounts of contrast material passing through gastric band (long arrow). Patient underwent surgery on same day, during which slipped gastric band with large amount of gastric edema was noted. Band was then removed without complication.

Fig. 7—44-year-old woman with laparoscopic adjustable gastric band placed 12 months earlier who presented to emergency department with coffee ground emesis and epigastric pain.

A, Anteroposterior abdominal scout image obtained at initial placement of gastric band shows normal band position.

B, Upper gastrointestinal image obtained after initial band placement shows normal findings. Note gastric pouch (arrow) is barely perceptible above band. This is normal finding when gastric band is first placed and before inflation of inner cuff.

C, Coned-down image of left upper quadrant at time of presentation illustrates O-shaped configuration of gastric band (arrow), “O” sign.

D, Upper gastrointestinal image obtained at time of presentation shows marked dilatation of gastric pouch with herniation of inferior stomach through band (arrows). There is complete obstruction at level of stoma. Patient immediately underwent surgery, which confirmed acute band slip. Edema of gastric pouch and hemorrhage of serosa were found. Band was removed without complication.

that is, with the long axis of the band orient-
ed at an acute angle with respect to the spine (Figs. 4–7). The diagnosis of band slippage in all four cases was supported by spot images from a UGI examination that showed eccentric gastric pouch dilatation with minimal or no passage of oral contrast material through the gastric band.

On the basis of radiographic findings or clinical presentation, all patients underwent exploratory surgery. The diagnosis of gastric band slippage was confirmed in all cases that showed the O sign on imaging. In none of the remaining 51 patients, including those who were symptomatic and those who were not
symptomatic, was the O sign seen on the initial scout image, suggesting that the O sign is a specific sign for gastric band slippage.

Discussion

A properly placed laparoscopic gastric band should have a rectangular appearance on a frontal abdominal radiograph owing to the anatomic landmarks used for band placement, which include the medial aspect of the right diaphragmatic crus and the angle of His. In this proper position, the band is perpendicular to the x-ray beam, so its anterior and posterior sides are directly superimposed. Normally, the band is obliquely oriented in the left upper quadrant and is located a few centimeters below the diaphragm. In the setting of gastric band slippage, as the stomach herniates superiorly to the band, the weight of the herniated stomach causes the band to tilt along its horizontal axis so that the anterior and posterior sides of the band are no longer superimposed. This creates the appearance of an O-shaped configuration on radiography, the O sign.

Surgeons use a fundoplication stitch to reduce the occurrence of gastric band slippage by preventing herniation of the stomach. This strategy does not appear to always be successful. In our small series, one case of stomach herniation and band slippage resulted from a disrupted fundoplication stitch. The remaining patients were found to have herniation of the stomach and band slippage with an intact fundoplication stitch. In all of these patients, significant gastric edema resulted, requiring removal of the gastric band.

In conclusion, laparoscopic adjustable gastric banding surgery is increasingly being used as a minimally invasive surgical intervention for weight reduction. An important potential complication of the procedure results from slippage of the gastric band. The consequences of band slippage may require acute surgical intervention. It is imperative that the physician is familiar with the surgical technique to correctly position the gastric band and the appearance of the gastric band when correctly and incorrectly positioned. Identification of the O sign on radiography can potentially aid the radiologist, surgeon, or emergency department physician to rapidly detect gastric band slippage for appropriate patient triage.

References