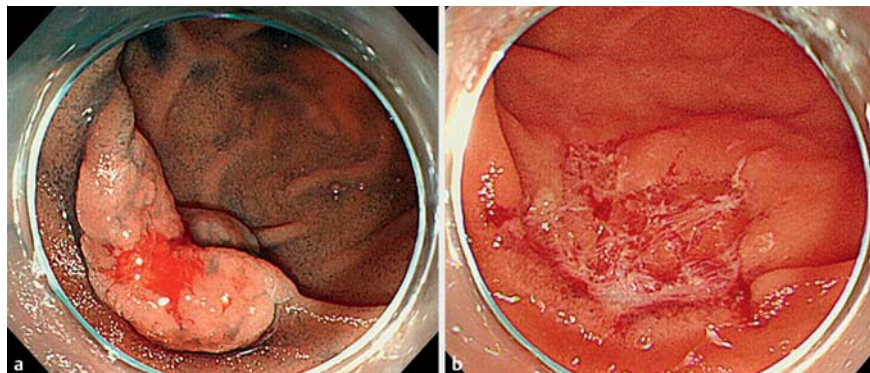


## Line-assisted complete closure of duodenal mucosal defects after underwater endoscopic mucosal resection

Duodenal endoscopic mucosal resection (EMR) carries a high risk of adverse events, including delayed perforation [1,2]. Because complete clip closure of mucosal defects can reportedly prevent post-procedural adverse events in the colorectum, we established a line-assisted complete closure (LACC) technique for large mucosal defects after colonic endoscopic submucosal dissection [3]. LACC can be useful in the duodenum, but its feasibility is unknown. Therefore, we investigated the feasibility of LACC of mucosal defects after underwater EMR in the duodenum.

Eight patients with 20-mm or larger duodenal tumors underwent LACC of mucosal defects after underwater EMR (► **Fig. 1**; ► **Video 1**). LACC was performed as follows [3]. First, a nylon line was tied to a clip (HX-610-090; Olympus, Tokyo, Japan) mounted on an applicator (HX-110LR; Olympus). The clip was then retracted into the applicator and inserted into the accessory channel. The clip-and-line system was placed on the normal mucosa at the proximal side of the defect (► **Fig. 2 a**). Another clip (without a line) was used to anchor the line to the other side of the normal mucosa. Both clips were gathered together by gently pulling the line (► **Fig. 2 b**). Additional clips were placed to achieve complete closure (► **Fig. 2 c**). Finally, the line tied to the clip was cut using scissor forceps (FS-3L-1; Olympus) (► **Fig. 2 d**). Complete closure was achieved in seven patients (88%) without adverse events; however, one 35-mm defect could not be closed completely, and delayed bleeding occurred. This patient was the first one to undergo duodenal LACC using a single clip-and-line system. We have recently used two or three clip-and-line systems to close large defects and have achieved complete closure [4]. Although an over-the-scope clip can reportedly be useful to prevent delayed perforations after duodenal EMR [5],



► **Fig. 1** The duodenal mucosal defect after underwater endoscopic mucosal resection (EMR). **a** Esophagogastroduodenoscopy showed a slightly elevated lesion 25 mm in size at the second portion of the duodenum. **b** The same area after piecemeal underwater EMR had been performed.

high-end devices are required and the size is limited. LACC is simple, affordable, and seems feasible for large duodenal mucosal defects after underwater EMR.

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### Competing interests

None

### The Authors

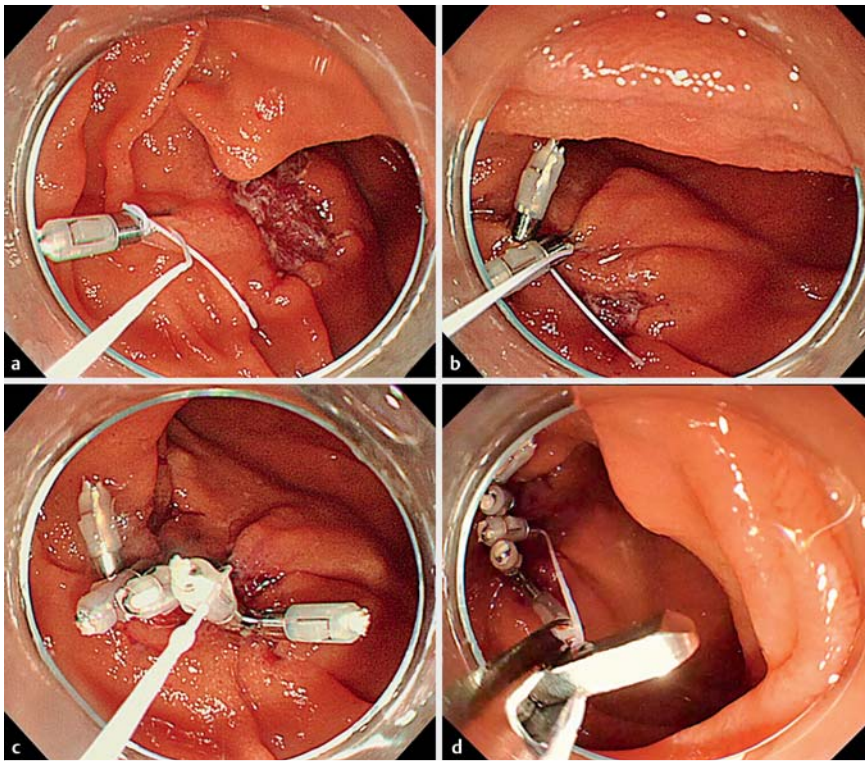
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### ► VIDEO 1



► Video 1: Line-assisted complete closure technique for a duodenal defect after underwater endoscopic mucosal resection of a slightly elevated 25-mm lesion.



► **Fig. 2** The line-assisted complete closure technique. **a** A clip-and-line system was placed on the normal mucosa at the proximal side of the duodenal defect. **b** The line was anchored to the distal side of the mucosa using another clip, and both sides of the defect were gathered together by pulling the anchored line. **c** Additional clips were placed to achieve complete closure. If the remaining defect was too large for complete closure using clips, another clip-and-line system was applied in the same way to close the defect. **d** The line attached to the clip was cut using scissor forceps.

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