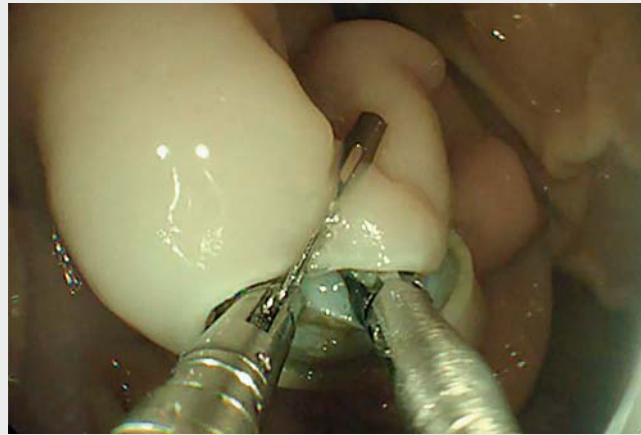


Twin grasper-assisted endoscopic mucosa-inverting closure for large perforations after endoscopic full-thickness resection: a new endoscopic technique

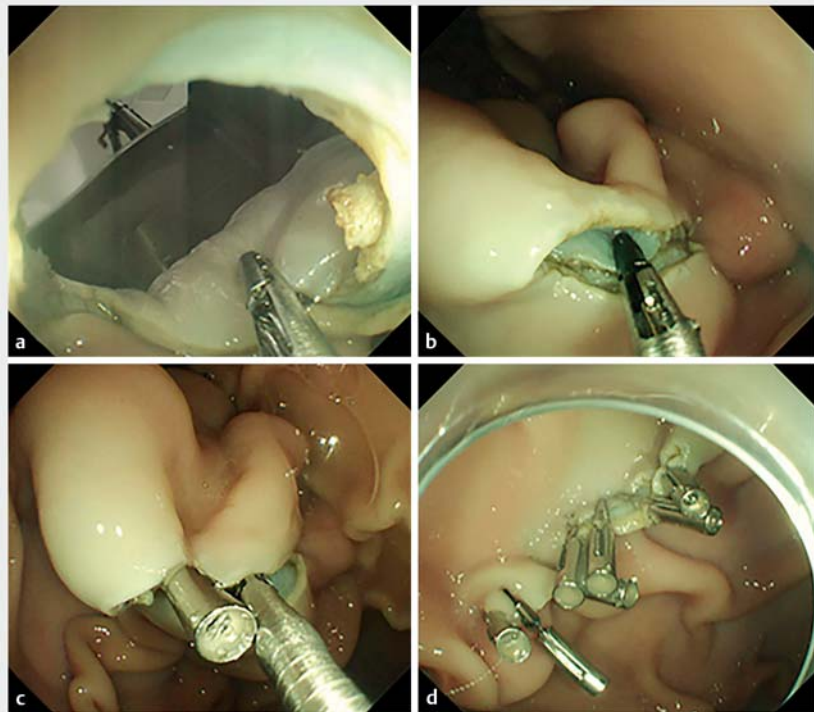
There is no commonly accepted technique for closure of large perforations (diameter >2 cm) after endoscopic full-thickness resection (EFTR), owing to inevitable limitations of each technique [1]. Gastrointestinal full-thickness defects can be closed by closing the mucosal layer only [2–4]. Here, we describe a new technique for closing large perforations. This technique uses through-the-scope (TTS) clips, which are widely used in practice, to close the mucosa in an inverted fashion with assistance of a twin grasper, thus overcoming the limitations of TTS clips. This technique may be a better choice for repair of large perforations after EFTR and can be easily adopted in local hospitals.

The procedural steps are shown in a porcine stomach with a 2-cm iatrogenic perforation created by EFTR (► **Video 1**). A twin grasper (Ovesco, Tübingen, Germany) was inserted into one of the working channels of an endoscope with two working channels (Olympus, Tokyo, Japan). Then, one of the arms was opened to grasp one side of the seromuscular layer of the perforation (► **Fig. 1 a**), and the other arm was opened to clamp the contralateral seromuscular layer. Thus, the mucosal layers were inverted and approximated tightly (► **Fig. 1 b**). TTS clips (Micro-Tech, Nanjing, China) were then inserted into another working channel to close the mucosa near to the twin grasper (► **Fig. 1 c**). Finally, we completed the closure by deploying further TTS clips from the midpoint of the incision to the bilateral incision margins (► **Fig. 1 d**). In this way, the inverted mucosal layer was closed, with the muscularis mucosa in tight apposition (► **Fig. 2**). Tightness of the closure was confirmed by insufflating carbon dioxide into the stomach and flushing water onto the serosal surface of the perforation; no running bubbles were observed.

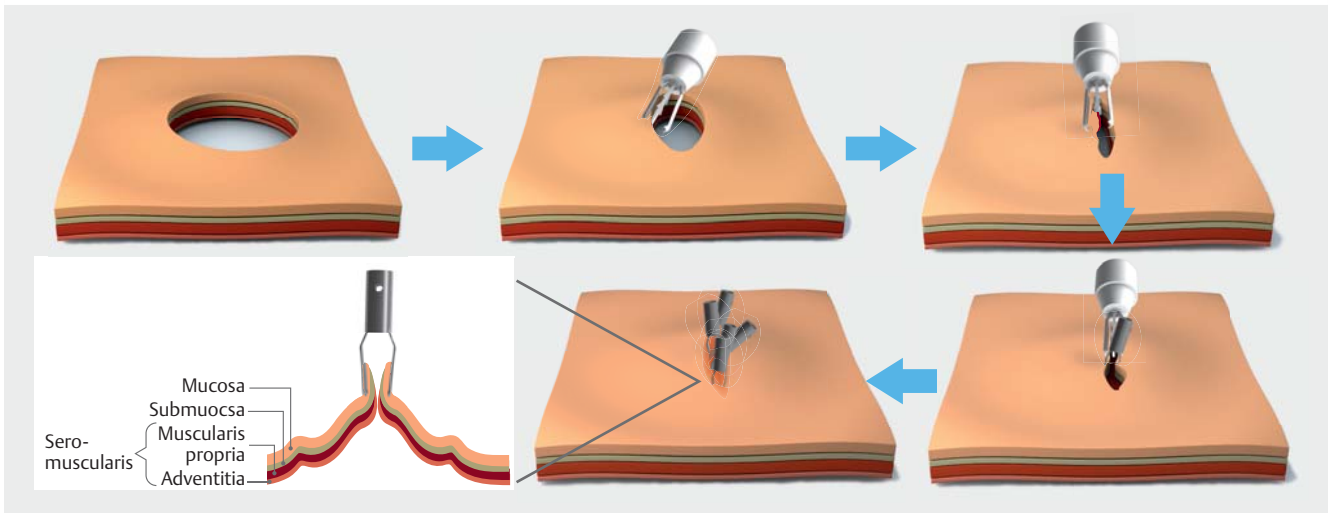
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► **Video 1** Closure of a full-thickness perforation, about 2 cm in diameter, using the twin grasper-assisted endoscopic mucosa-inverting closure technique.



► **Fig. 1** Endoscopic images. **a** The twin grasper clamped one side of the seromuscular layer. **b** The twin grasper approximated the seromuscular layers. **c** The inverted mucosal layers were closed by metal clips. **d** Complete closure of the perforation.



► **Fig. 2** Schematic diagram of the new technique. After creation of a large perforation by endoscopic full-thickness resection, a twin grasper was used to grasp one side of the seromuscular layer, followed by the contralateral side, thus approximating the mucosal layers. A through-the-scope clip was then used to close the inverted mucosal layers, providing good conditions for mucosal healing.

Competing interests

The authors declare that they have no conflict of interest.

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