



## Endoscopic slip-knot clip suturing method: prospective pilot study (with video)

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**Background and Aims:** We developed a suturing method with a slip-knot string and clips for a single-channel endoscope. The feasibility of the slip-knot clip suturing method was evaluated in this clinical pilot study.

**Methods:** Ten patients underwent endoscopic submucosal dissection for colorectal and duodenal tumors 5 cm or less. A slip-knot loop can be tightened when tension is applied to the free end of the string. A clip and string can be passed through an instrument channel (3.2 mm) of a single-channel endoscope. The slip-knot loop is anchored onto the mucosal defect's proximal margin with the clip. Additional clips anchoring the slip-knot loop are placed at the opposite side of the margin. The slip-knot loop is tightened by pulling the string. Additional clips are placed to achieve complete closure.

**Results:** The mean size of resected specimen was  $34.4 \pm 10.0$  mm. The success rate of the slip-knot clip suturing method was 90% (9/10). In the first patient, the string was cut because of friction, and the patient dropped out of the study. After the failure of the first patient, we used wet string to reduce friction, and slip-knot string worked effectively. The mean procedure time was  $18.2 \pm 3.3$  minutes.

**Conclusion:** The slip-knot clip suturing method could close large mucosal defects completely using a single-channel endoscope. (Clinical trial registration number: UMIN000017583.)

Endoscopic submucosal dissection (ESD) has made it possible to resect large lesions in an en bloc fashion. ESD requires a high level of technical expertise and fine endoscope control.<sup>1-3</sup> Even when ESD is successfully performed, there is a risk of delayed perforation or bleeding because of the artificial ulcer. Several studies advocated closure of the defects after EMR and ESD with endoscopic clips to decrease the number of delayed adverse events.<sup>4,5</sup> However, clips have limited opening widths

*Abbreviation: ESD, endoscopic submucosal dissection.*

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**This video can be viewed directly from the GIE website or by using the QR code and your mobile device. Download a free QR code scanner by searching "QR Scanner" in your mobile device's app store.**

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and are not always feasible, especially for larger defects after ESD.

There is an endoscopic suture method using an endo-loop and several clips.<sup>6</sup> The endoscopic purse-string suture could close large mucosal defects. However, the endoscopic purse-string suture method requires a double-channel endoscope, which is not always available.

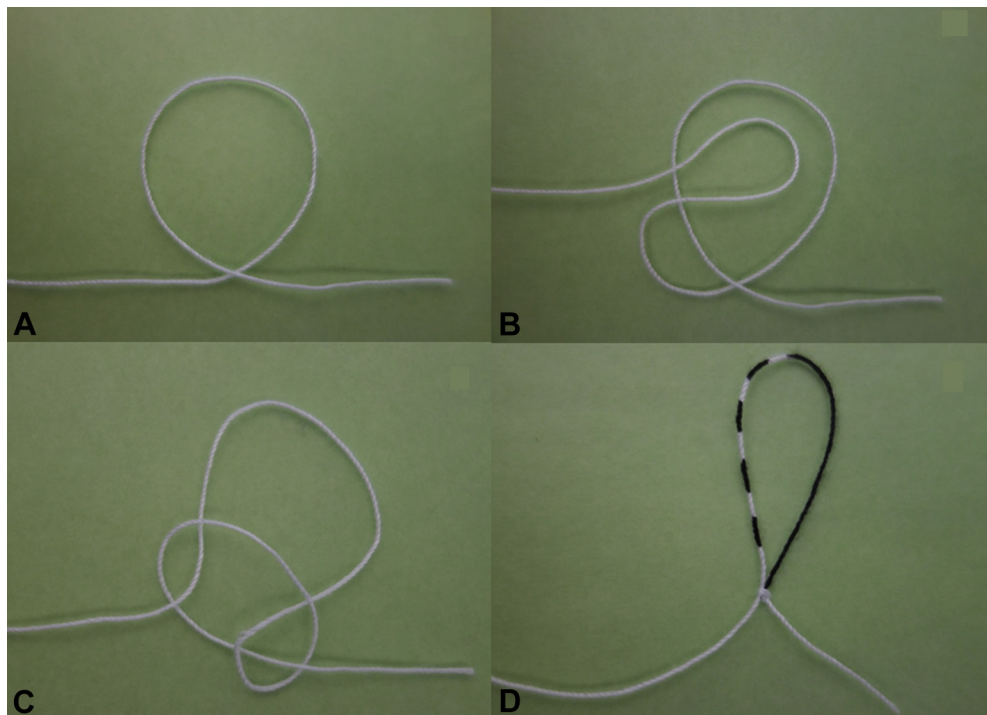
We previously reported a suturing method with a slip-knot string and clips for a single-channel endoscope

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**Figure 1.** Slip knot tying. **A**, Form a first loop in the end of the string. **B**, Create a second loop in the long end of the string. **C**, Pull the second loop through the first loop. **D**, Pull until the knot is tight. The slip side of the loop is painted with a dashed spaced line with permanent marker and the opposite side as a continuous line.

in an ex vivo animal model.<sup>7,8</sup> Here, we report the results of a prospective clinical pilot study for a slip-knot clip suturing method and describe the skills of the procedure.

## METHODS

### Patients

The present study involved 10 patients who underwent ESD for colorectal and duodenal tumors 5 cm or less at Keio University Hospital between October 2015 and April 2016. This study protocol was approved by the Institutional Review Board of Keio University School of Medicine (registration number, 20150003 [May 1, 2015]), and written informed consent was obtained from all patients.

### Slip-knot clip suturing method

Braided polyester (USP 3-0, \$19.8/100m; Natsume Seisakusyo Co. Ltd., Tokyo, Japan) was used as the string. A slip knot is a type of knot that can “slip” along the string. The loop can be tightened when tension is applied to the free end of the string. Slip-knot tying is described in Figure 1. The slip side of the loop was painted as a dashed spaced line with permanent marker (Hi-McKee; Zebra Co. Ltd., Japan), and the opposite side was painted as continuous line.

We used the slip-knot clip suturing method to anchor the slip-knot loop onto the mucosal defect’s proximal

margin with the first clip, followed by the insertion of a second clip to anchor the slip-knot loop at the opposite side of the margin (Figs. 2 and 3; Video 1, available online at [www.giejournal.org](http://www.giejournal.org)). At that time, a second clip was hooked on the slip side of the loop (painted as a dashed spaced line). The clip and string can be passed through the instrument channel (3.2 mm) of a single-channel endoscope. Then, the slip-knot loop was tightened by pulling the free end of the string. Additional endoscopic clips were placed to achieve complete closure. The string was cut with Coagrasper or Dual knife (Olympus, Japan) using radiofrequency current. Finally, endoscopic inspection was performed to visually confirm complete closure. A single-channel endoscope (PCF-Q260J or GIF-Q260J; Olympus) was used in this study. All slip-knot clip suturing was performed by 3 experienced endoscopists (T.N., Y.O., and N.Y.). Their previous experience with this technique in an ex vivo animal model has been published.<sup>7,8</sup>

### Evaluation of the procedure

We evaluated the success rate, mean procedure time, and adverse events. Procedure time was measured from the insertion of first clip to completion of the procedure.

### Statistics

All continuous variables were expressed as mean  $\pm$  standard deviation.

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