

# Endoscopic slipknot clip suturing method: an ex vivo feasibility study (with video)

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**Background and Aims:** We developed a suturing method with slipknot string and clips for the single-channel endoscope. The aim of this study was to analyze the efficacy of the slipknot clip suturing method.

**Methods:** Twelve 30-mm mucosal defects were created by endoscopic submucosal dissection in an ex vivo bovine model. A slipknot 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. The clip and string can be passed through the instrument channel of the single-channel endoscope. The slipknot loop is anchored on the mucosal defect’s proximal margin with the clip. An additional clip anchored at the slipknot loop is placed on a different side of the margin. The slipknot loop is tightened by pulling the string. Additional clips are placed to achieve complete closure.

**Results:** All 12 defects were completely closed by the slipknot clip suturing method. The procedure time decreased significantly from the first 6 procedures to the last 6 procedures ( $865 \pm 213$  vs  $556 \pm 103$  seconds,  $P = .009$ ).

**Conclusions:** The slipknot clip suturing method makes it easy to close a large mucosal defect completely by using a single-channel endoscope.

An endoscopic suture method that uses an endoloop and several clips was reported.<sup>1</sup> The endoloop (MAJ-254; Olympus, Tokyo, Japan) and clip were inserted simultaneously through the double-channel endoscope. The endoloop was anchored onto the mucosal defect’s distal margin with the clip, followed by insertion of additional clips to anchor the endoloop at different sides of the margin. Finally, the endoloop was tightened by slight pulling of all the edges together. However, the endoscopic purse-string suture method requires a double-channel endoscope, which is not always available.

*Abbreviation:* ESD, endoscopic submucosal dissection.

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We previously reported the concept of suturing with a slipknot string and clips for the single-channel endoscope.<sup>2</sup> This report describes the details of the technique and the results of the feasibility study in an ex vivo animal model.

## MATERIALS AND METHODS

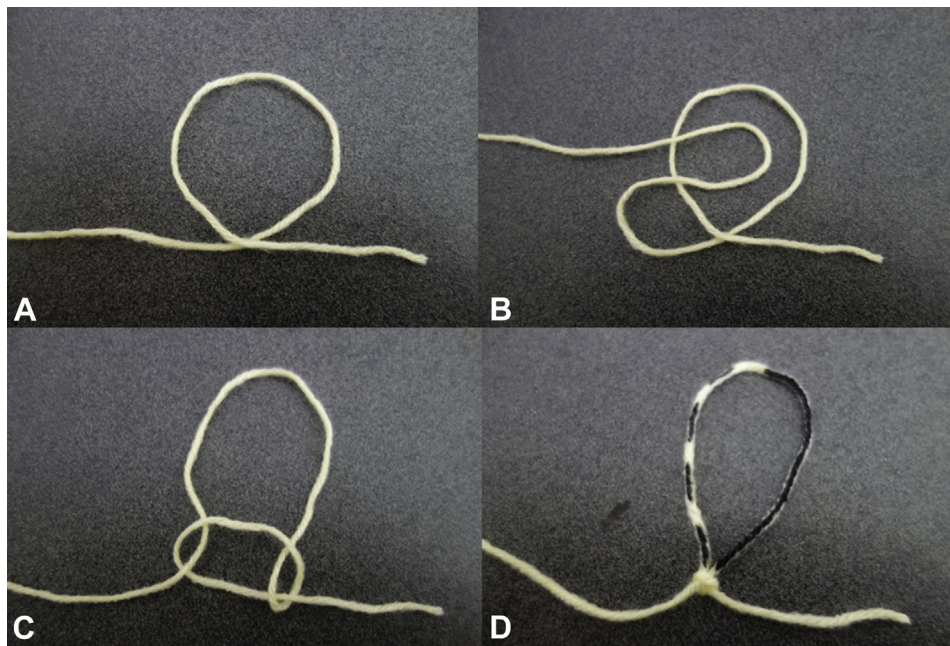
### Ex vivo bovine colon model

We used a commercially available bovine colon. The colon was inverted to an inside-out position to expose the mucosal side. After inflation of the bowel, marking of the lesions was performed by dots around a standard 28-mm circular template. Normal saline solution was injected to create good protrusion of the targeted mucosa. Twelve 30-mm mucosal defects were created by endoscopic submucosal dissection (ESD).

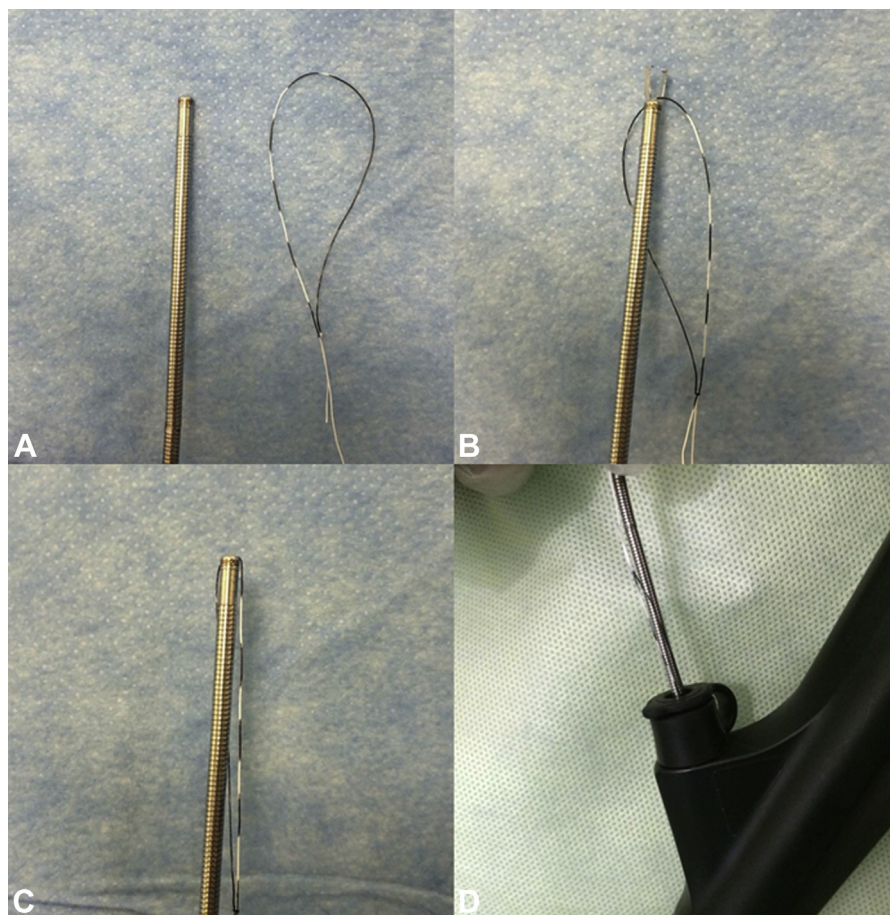
### Slipknot clip suturing method

A slipknot 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.

Slipknot tying is described in [Figure 1](#). The slip side of the loop is painted as a dashed spaced line with permanent marker (Hi-McKee; Zebra Co Ltd, Tokyo, Japan). The opposite side of the loop is painted as a solid line. The oil-based marker makes it easy to cut the string with Coagrasper (Olympus). In the slipknot clip suturing method, the slipknot loop is anchored onto the mucosal defect’s proximal margin with the



**Figure 1.** **A**, Slipknot tying. First, form a loop at the end of the string. **B**, Create a second loop at the long end of the string. **C**, Pass the second loop through the first loop. **D**, Pull until the knot is tight. The slip side of the loop is painted as a dashed line with permanent marker. The opposite side of the loop is painted as a continuous line.



**Figure 2.** Clip and slipknot loop. **A**, Clip and slipknot loop string. **B**, A clip is slightly opened and is hooked on the loop. **C**, The clip is closed. **D**, Clip and string can be passed through the instrument channel of the single-channel endoscope.

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