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Debates on Colorectal Endoscopic Submucosal Dissection — Traction for Effective Dissection: Gravity Is Enough

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Colorectal endoscopic submucosal dissection (ESD) still remains a technically difficult procedure. The maintenance of tissue tension and good submucosal exposure during dissection is one of the most important factors for an effective and safe dissection. Although various traction methods have been developed, traction by gravity is one of the most useful method for colorectal ESD. Traction using adjunctive devices can thus be reserved for extremely difficult cases or for endoscopists in their learning periods for colorectal ESD.

Key Words: Colorectal neoplasms; Endoscopic submucosal dissection; Traction; Gravitation

INTRODUCTION

As a result of the development of endoscopic submucosal dissection (ESD), the *en bloc* resection of larger gastrointestinal neoplasms can be performed successfully. However, ESD still has many limitations, including its technical difficulty, long procedure times, and risks of perforation and bleeding. Because the colorectal wall is much thinner than the gastric wall, the risk of perforation is considerably greater in colorectal ESD than in gastric ESD. The perforation rates associated with colorectal ESD were approximately 10% in several reports[1,2] although this rate has been decreasing as the skills, materials, and devices for ESD are improved.

Adequate tissue tension and good visibility of the tissue to be dissected are very important for effective and safe dissections, and they can be achieved by traction of the tissue to be dissected. In this article, we will discuss various techniques for achieving tractions during ESD and their advantages and disadvantages.

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ROLE OF TRACTION DURING ESD

Traction decreases the contact area between the tissue and the electrosurgical knife by increasing the tissue tension (Fig. 1). The current density increases as the contact area decreases, which enables a more effective cut.

Secondly, traction can provide better submucosal exposure (Fig. 2). The precise dissection of the submucosal layer is the most important step for preventing perforation, and the electrosurgical knife should always aim for the submucosal layer during dissection. Therefore, improved submucosal exposure through traction is helpful for more effective and safer dissections.

HOW TO ACHIEVE TRACTION FORCES DURING ESD?

Surgeons are usually aided by the hands of assistants or by various instruments to maintain the tissue tension and visibility of the tissue to be dissected. In ESD, achieving good traction is not easy because only an electrosurgical knife can be passed through the single working channel. Therefore, ESD can be compared to one-handed surgery.

The transparent distal attachment is a simple device that provides tissue tension and submucosal exposure. By inserting the transparent hood in between the flap and its base, more submucosa can be exposed and better tissue tension can be achieved (Fig .3). This technique can also keep the tip

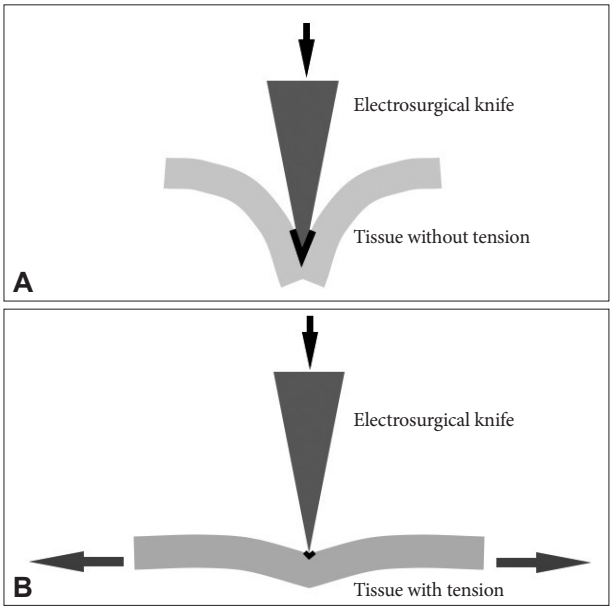

Fig. 1. Association between tissue tension and contact area. (A) Before applying tension. (B) After applying tension. Decreased contact area from increased tissue tension makes for an effective dissection.

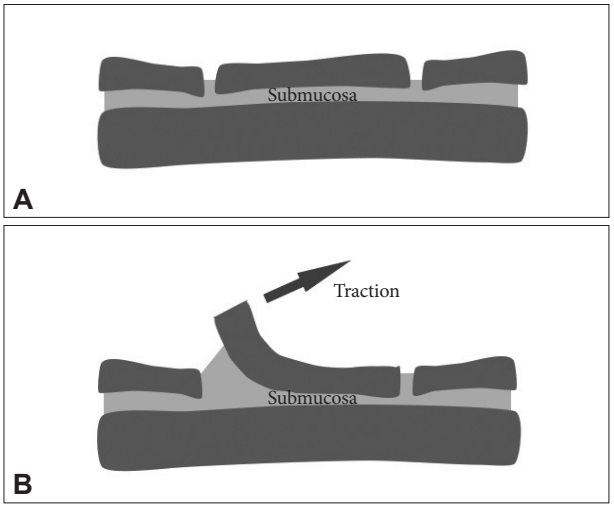

Fig. 2. Improved submucosal exposure by traction. (A) Before traction. (B) After traction.

of the endoscope at a suitable distance from the tissue such that the phenomenon of red-out can be avoided.

Traction force can be simply achieved through gravity.[3] The direction of the traction force can be controlled by changing the position of the patient. While the patient's position during gastric ESD is limited to left lateral decubitus, various positions, even including the prone position are allowed during colorectal ESD. The optimal position is estimated by the location of fluid in the lumen. Locating fluid on the opposite side of the lesion, which can cause the flap to be strained to the side of the luminal center, is usually preferred. However, submucosal exposure may not be insufficient in the early stages

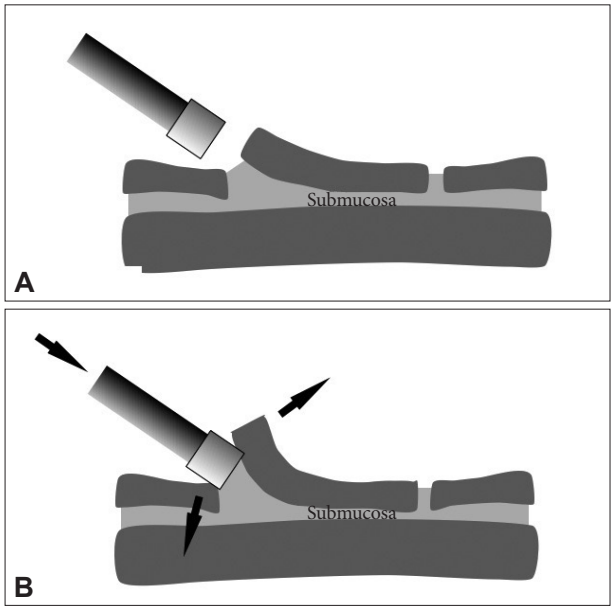

Fig. 3. Role of the distal transparent hood. (A) Insufficient submucosal exposure can be improved (B) by gently pushing the hood into the submucosal layer.

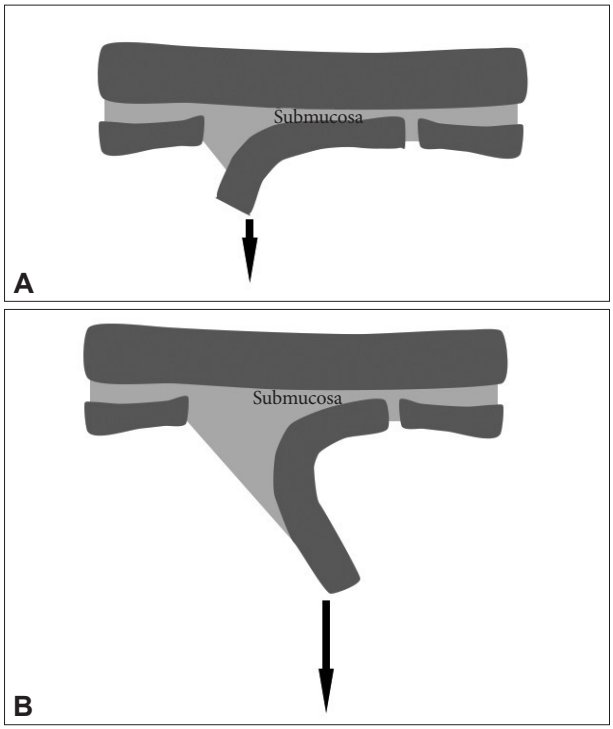

Fig. 4. The traction force by gravity during dissection. (A) Early stage of dissection. (B) After the dissection has progressed.

of the dissection because the flap has not yet been sufficiently prepared. As the dissection progresses, the weight of the flap increases, and thus the traction force increases due to gravity (Fig. 4). Insufficient submucosal exposure at an early stage can be complemented by the submucosal injection of long-lasting materials, such as glycerol or hyaluronic acid[4] and the

use of a transparent hood.

The traction force by gravity can be strengthened by applying a small weight.[5] This sinker system consists of a 1-g weight, a clip, and a connecting nylon thread. By attaching the clip to the mucosal edge after a circumferential incision, the traction force due to weight allows a better submucosal exposure.

Various other adjunctive methods have been developed to control and strengthen the traction force. A thread and a clip can also be used for traction. The clip is attached to the tip of the flap and the end of the thread is pulled though a thin tube by an assistant during the colorectal ESD. Pushing the endoscope and pulling the thread can together lift the flap.[6] Various methods using clips and a thread has also been attempted in esophageal or gastric ESD.[7-12]

Table 1. Trials to Create the Traction Force during Endoscopic Submucosal Dissections

Classification	Name of the method	Materials	Organ	Authors	Country
Clip and thread	Internal traction	Clips and a nylon	Stomach	Chen et al.[8]	Taiwan
	Clip traction	A clip and a nylon	Esophagus	Ota et al.[9]	Japan
	Per-oral traction-assisted	A clip and a silk	Stomach	Jeon et al.[10]	Korea
	Pulley method	Clips and dental floss	Stomach	Li et al.[11]	Taiwan
	Cross-counter technique	A thin tube, a clip, a nylon, (and a balloon overtube)	Stomach and colorectum	Okamoto et al.[6,12]	Japan
Clip and elastic material	Traction with a rubber band and clips	A rubber band and clips	Stomach and colorectum	Lee et al.[13]	Korea
	Clip-band technique	A rubber band and clips	Animal, *in vivo* stomach	Parra-Blanco et al.[14]	Spain
	Medical ring	A rubber band and clips	Stomach	Matsumoto et al.[15]	Japan
	S-O clip	A spring and clips	Stomach and colorectum	Sakamoto et al.[16,17]	Japan
Weight	Sinker	A sinker, a clip, and a silk	Colorectum	Saito et al.[5]	Japan
Magnet	Magnet-anchor	An extracorporeal electromagnet and a small magnet	Stomach	Gotoda et al.[18]	Japan
Forceps	External grasping forceps	Additional forceps separate from the endoscope	Stomach and rectum	Imaeda et al.[19,22]	Japan
	Two-point fixed ESD	A transparent hood with a forceps channel	Esophagus and rectum	Motohashi et al.[20,21]	Japan
	Endolifter	A retractable grasping forceps attached to a transparent cap by a hinge	Animal, *ex vivo* stomach	Teoh et al.[23]	Hong Kong
Double-channel endoscope	Sheath-assisted counter traction	An injection sheath and a double-channel endoscope	Stomach	Hijikata et al.[31]	Japan
New double-channel endoscope	R-scope	A multibending system and two movable instrument channels	Stomach	Yonezawa et al.[32]	Japan
Double endoscope	Thin endoscope-assisted	A thin endoscope and a clip	Stomach and rectosigmoid	Uraoka et al.[24,25]	Japan
	Transnasal endoscope-assisted	A thin transnasal endoscope	Stomach	Ahn et al.[27,28]	Korea
	Double-endoscope ESD	A thin endoscope and a grasping forceps	Stomach	Higuchi et al.[26]	Japan
Percutaneously assisted	Percutaneous traction-assisted EMR	A mini-laparoscopic port	Stomach	Kondo et al.[29]	Japan
	PEG-minitrocar (PMT)	PEG-minitrocar	Animal, *in vivo* stomach	Von Delius et al.[30]	Germany

ESD, endoscopic submucosal dissection; EMR, endoscopic mucosal resection; PEG, percutaneous endoscopic gastrostomy.

Table 2. Traction by Gravity versus Traction by Adjunctive Devices for Colorectal Endoscopic Submucosal Dissection

	Traction by gravity	Traction by adjunctive devices
Applicable location	Entire colon and rectum	May be limited to the distal colorectum
Additional devices for traction	Not required	Required
Additional time for traction	Minimal	Required
Endoscope withdrawal before traction	Not required	May be required
Control of traction direction	By position change	May be limited
Control of traction force	Not controllable	Controllable in majority of the methods
Submucosal exposure at the early stage of dissection	May be insufficient	May be improved
Submucosal exposure when fibrosis presents	May be insufficient	May be improved
Interference in the movement of the endoscope	No	Probable
Preference of experts	In most cases	In limited cases

The traction force can be prepared internally using elastic materials. A rubber band between a clip attached to the tip of the flap and another clip attached to normal mucosa can provide a continuous traction force during colorectal ESD.[13] The method can also be applied to gastric lesions,[13-15] and a thin spring can replace a rubber band.[16,17]

The use of an extracorporeal electromagnet was attempted in gastric ESD.[18] In this trial, a large extracorporeal electromagnet was used to attract a small magnet that was attached to the mucosal edge for traction.

External forceps can be used for traction in rectal ESD.[19] After a pair of bendable forceps is introduced with the help of other grasping forceps, and fixed to the mucosal edge, the bendable forceps are bent or pulled to elevate the lesion. Forceps to elevate the mucosa can be introduced through a channel within a specialized transparent hood.[20] Similar methods have also been used for esophageal[21] or gastric ESD.[22,23]

An additional thin endoscope can be introduced for traction during rectal ESD,[24] and this method has also been attempted during gastric ESD.[25-28]

Percutaneous tractions,[29,30] using a catheter and a double channel endoscope,[31] and development of a new endoscope with two movable instrument channels[32] have each been tested for gastric ESD. The various trials attempting to achieve a proper traction force during ESD are listed in Table 1.

GRAVITY VERSUS ADJUNCTIVE METHODS FOR TRACTION

One of the advantages of traction by gravity is that it does not require any additional devices. Moreover, the direction of traction force can be easily controlled by changing the patient's position. As mentioned above, traction force by gravity may not be sufficient at early stages of dissection, in which case the traction force can be complemented by a transparent hood and submucosal injection.

In contrast, traction by adjunctive devices can create a good traction force from the early stages. It may be more useful when submucosal exposure is insufficient because of fibrosis. However, traction by adjunctive devices requires additional materials and time. Specialized, expensive, or even huge devices may be required.[18,32] Some methods are more invasive than conventional ESD,[29,30] and the endoscope should occasionally be withdrawn and reinserted to provide traction.[5-12,19,22] The movement of the primary endoscope may be hindered by the second endoscope to maintain traction.[24-27] Moreover, majority of the methods has not been tested in colorectal ESD (Table 1).

The advantages and disadvantages of traction by gravity versus traction by adjunctive devices are listed in Table 2.

CONCLUSIONS

Colorectal ESD remains a technically difficult procedure. The maintenance of tissue tension and good submucosal exposure during dissection is one of the most important factors for an effective and safe dissection. Various traction methods using adjunctive devices have been developed and may be useful for difficult cases. However, they have many limitations and require additional effort.

Traction by gravity is not only a simple method, but also a useful method for most colorectal ESD cases and is preferred by majority of experts. Traction using adjunctive devices can thus be reserved for extremely difficult cases or for endoscopists in their learning periods of colorectal ESD.

Conflicts of Interest

The author has no financial conflicts of interest.

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