



# ESD

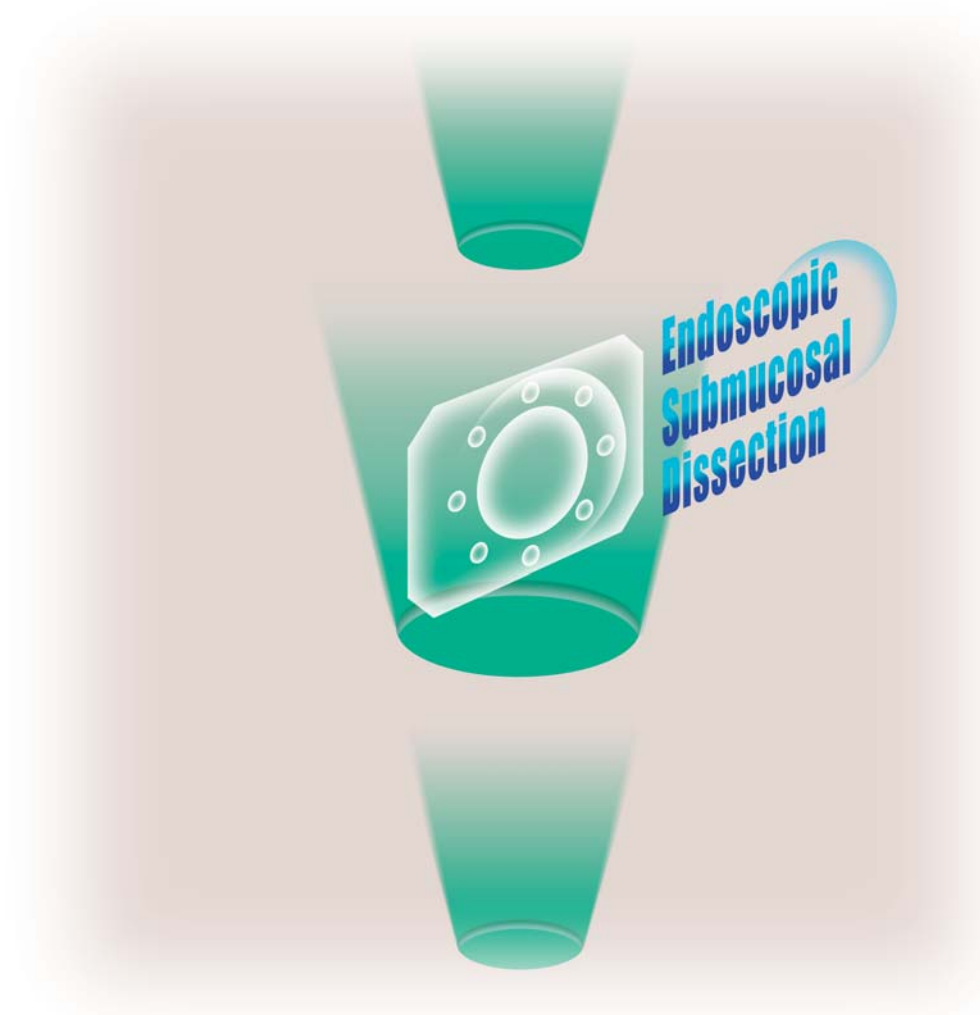
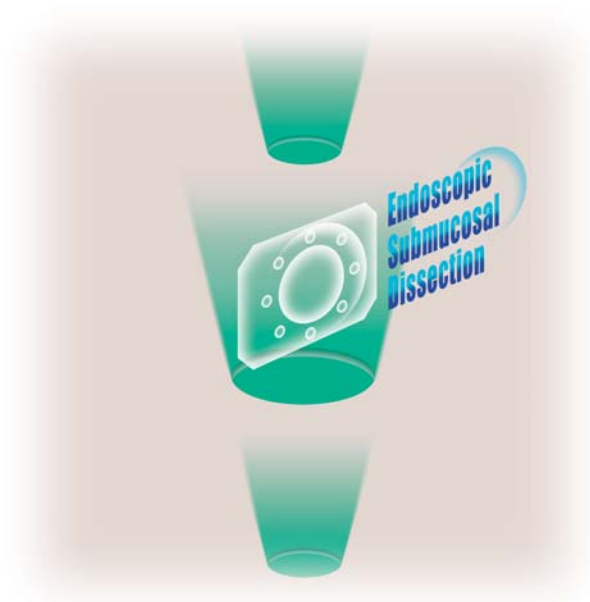
## Endoscopic Submucosal Dissection

— Techniques for the Stomach and Oesophagus —

### ESD

#### Endoscopic Submucosal Dissection

— Techniques for the Stomach and Oesophagus —



Takuji Gotoda National Center for Global Health and Medicine  
Hiroyuki Ono Shizuoka Cancer Center  
Tsuneo Oyama Saku Central Hospital  
Naohisa Yahagi Keio University  
Haruhiro Inoue / Hitomi Minami / Yoshitaka Sato  
Showa University Northern Yokohama Hospital  
Toshihiko Doi National Cancer Center Hospital East

# Stories of ESD Device Development

## ITknife

Takuji Gotoda, National Center for Global Health and Medicine

I became a resident in the Endoscopy Division at the National Cancer Center Hospital in June 1995. At that time, Dr. Koichi Hosokawa (presently at Suwa Central Hospital) who was an inventive-minded man was attempting to improve the needle knife for use in ERHSE. After developing distal tips from various materials aimed at preventing perforation, he eventually arrived at what is now called ITknife. When I returned to the Endoscopy Division after completing my rotation in 1996, the chief resident, Dr. Hiroyuki Ono (currently Director, Endoscopy and GI Oncology Division, Shizuoka Cancer Center) was struggling with ESD using ITknife and experiencing difficulties that are unimaginable today. The lucky thing for me was that there was no other resident specialising in the upper gastrointestinal tract at that time. I was able to gain experience with ITknife by assisting Dr. Ono. I originally became a Cancer Center resident with the hope of working in colonoscopy, but a happy combination of coincidence and luck led to my encounter with Dr. Hosokawa, Dr. Ono, and ITknife.

## ITknife2

Hiroyuki Ono, Shizuoka Cancer Center

I have experienced few problems with ITknife, other than the fact that the cutting performance tends to deteriorate in cases with severe fibrosis such as ulcer scars. A few other doctors have also noted that lateral cutting is difficult with ITknife and that the ceramic tip at the distal end catches in the mucosa. So I decided to try and find a way to improve the cutting performance of the conventional ITknife while maintaining its advantages. My idea was to attach the three short blades shaped like the three-pointed star of Mercedes-Benz at the bottom of the ceramic tip which are perpendicular to the conventional knife blade. I proposed this idea to Olympus for actual prototyping. When I applied the prototype in an actual clinical procedure after confirming its safety with a pig stomach, I was surprised by how well the cutting ability increased. I convinced myself with Drs. Inui and Hasuike saying that it would be hard to go back to the conventional ITknife once you have used ITknife2 and that this would be the definitive version for the ITknife technique.

## HookKnife

Tsuneo Oyama, Saku Central Hospital

It started when I intentionally bent the distal end of a needle knife myself, thinking that I would be able to incise and dissect the mucosa more safely if the distal end of a needle knife were bent into an L-shape so that it could hook the mucosa before cutting. Later, I asked Olympus to create a similar prototype, which was later provided with a rotation function and eventually commercialised.

## FlexKnife

Naohisa Yahagi, Keio University

In the beginning, we were looking for a knife that was flexible, easy to manipulate and had an adjustable distal end length. We noticed that the distal end of the thin snare (SD-7P) can be used to incise the mucosa and initially performed ESD as a thin snare technique. But this technique brings with it such problems as variation of the distal end length or splitting of the wire's distal end during a procedure. We therefore created FlexKnife by increasing the wire strength and adding a stopper mechanism.

## TriangleTipKnife

Haruhiro Inoue / Hitomi Minami / Yoshitaka Sato, Showa University Northern Yokohama Hospital

Hooks are used in basic surgical procedures (laparoscopic cholecystectomy), as well as in ESD. Axis alignment was difficult when using a flexible endoscope, so I invented TriangleTipKnife. This had three tips at the distal end pointing in three different directions, which act like hooks, but do not need axis alignment.

## DualKnife

Naohisa Yahagi, Keio University

As suggested by the word “dual,” DualKnife can be set to either of two lengths, eliminating the need for the precise knife length adjustment required with FlexKnife. The needle knife design of DualKnife provides sharp incision performance, as well as easy removal of any tissue that coagulates on the knife tip. In addition, even when the knife is retracted completely, the small disc on the tip remains projected so that it can easily be used for coagulation and haemostasis by contact. In my opinion it is a safer, easier-to-use knife than FlexKnife, solving the problems I experienced with FlexKnife.

## Support Devices

Toshihiko Doi, National Cancer Center Hospital East

ESD has proven that it can expand the indications and improve the curability of EMR. However, ESD's practice remains limited and it is relegated to a minor position in the hierarchy of EMR procedures. When considering how to establish ESD as a more universal technique, keep in mind that the basic endoscopic treatment is biopsy. This led us to the idea that we should try to develop a mucosal incision technique that resembles biopsy. What usually throws off first-time users of ITknife is that, while previous treatment devices are manipulated with a pulling action, ESD with ITknife depends on advanced endoscope manoeuvring except for the sections that can be cut by pulling ITknife. In particular, the actions required to make introductory holes with a needle knife tend to be very unstable. So, keeping in mind that biopsy-style manipulations are the cornerstone of any endoscopic treatment, I began to search for a way to perform ESD using similar manipulations. My first thought was that it would be safer if a hole could be made by grasping the mucosa via the introductory holes and then supplying current. We also designed HotClaw as a tool for lifting the mucosa for incision and dissection. Our intention was to reduce the risk of perforation by applying an upward force instead of a downward cutting force. For Coagrasper, we focused on how to stop bleeding — one of the most critical complications associated with ESD — more quickly and more effectively. Some hospitals still use the hot biopsy forceps for haemostasis, but as a device exclusively designed for haemostasis, Coagrasper's shape and electrical characteristics are suitable for haemostasis. Our goal has always been to develop an ITknife technique that is safe and that can be performed by beginners.

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# ITknife2

Model **KD-611L**

**Dr. Takuji Gotoda**

National Center for Global Health and Medicine

## Interview With The Expert

**Q.** What are the advantages of ITknife2?

**A.** Like ITknife, ITknife2 features a long stroke and can be easily operated by an assistant, making it possible to complete incision quickly with a small number of assistants. Three blades attached to the back of the insulated ceramic tip make it much easier to manipulate, so it is no longer necessary to apply the blade strongly in a downward angle as it was with ITknife. This facilitates horizontal cutting that previously would have required application of a special technique. In addition, while mucosal incisions were difficult with ITknife because it could not pull the tissue sufficiently for cutting due to perpendicular approach of the blade, they can be done smoothly and easily with ITknife2, by manipulating it in the same way as HookKnife.

**Q.** Are there any weak points of ITknife2?

**A.** I don't think there is anything in particular that ITknife2 is not good at, but there are a couple of points where some care is required. The first is related to the three blades; though they allow the knife to be used like a HookKnife, you should be careful not to scratch or hook the surface of the proper muscle layer during dissection. Secondly, using too much of a downward angle could result in a perforation, even during mucosal incision, as well as ITknife. The key thing is how you apply tension in the optimum incision/dissection direction and how you position the endoscope for this purpose (basically by means of the left/right angle control and the twisting control by the left hand).

**Q.** Under what circumstances would you also use another device?

**A.** For the reasons above, manipulation of ITknife2 is very delicate in narrow or thin-walled region; for example in ESD that necessitates endoscope retroversion at the duodenal bulb, ESD of cardiac lesion, or oesophageal ESD. In these cases, I often use a needle knife with a distal attachment which facilitates stable manipulation under sufficient local injection. There are also cases in which confirmation of the endoscope manipulation orientation is difficult because the dissection plane is covered by a dissected segment. In such a case, I use a distal attachment to ensure the submucosal view, apply tension to the dissection plane and dissect the submucosal layer on the front carefully using a needle knife. The operation I am most fond of personally is carefully dissecting fibrotic tissues using a needle knife while ensuring the view with a distal attachment.

## Applicability of ITknife2

### Difficulty per region

⊙: Easy. ○: Ordinary. △: Difficult. ▲: Very difficult.

Region	Difficulty	Notes
Cardiac region	○	Bleeding occurs but approach is possible.
Posterior wall of upper body	○	Techniques of reliable haemostasis and perforation closure are needed.
Lesser curvature of lower body	○	Sometimes, hard to approach.
Greater curvature of antrum	⊙	Target period is 45 min for a beginner under the guidance of an expert.
Fornix	▲	Refer to advanced hospitals. Lapa is also an option.
Lesser curvature of middle body	○	Selection and exchange of endoscopes by the situations are important.
Greater curvature of lower body	△	Getting harder as time progresses. Difficult to manipulate the endoscope both upward and downward.
Anterior wall of antrum	⊙	Target period is 30 min for a beginner under the guidance of an expert.
Lesser curvature of upper body	○	Bleeding occurs but approach is possible.
Greater curvature of middle body	△	A lot of bleeding. Blood and fluid pool. Refer to advanced hospitals. Lapa is an option.
Anterior wall of lower body	○	Selecting of the endoscope is very important.
Posterior wall of antrum	○	Manipulate the left/right angulation so that treatment can be done at 6 o'clock position.
Greater curvature of upper body	▲	A lot of bleeding. Blood and fluid pool. Refer to advanced hospitals. Lapa is an option.
Anterior wall of middle body	△	Hard to approach. Perform a simulation in advance.
Posterior wall of lower body	○	Start from the greater curvature side where blood tends to pool.
Pyloric ring	△	Retroversion manoeuvre is required at the duodenal bulb.
Anterior wall of upper body	△	Difficult to approach the lesion.
Posterior wall of middle body	○	Simulate procedure, thinking of gravity and patient positioning.
Lesser curvature of anterior wall	△	Do not underestimate this lesion. Pooled blood and fluid make the operation difficult.

Sedation	Intravenous anaesthesia	Premedication	General anaesthesia	Monitoring
	Pentazocine 15 mg + Midazolam 5 mg Propofol depending on cases	Buscopan (scopolamine butylbromide)* 20 mg Atropine sulfate 0.5 mg depending on cases	Recommended for two-hour procedure and more, an elderly person, a patient with respiratory complications.	Blood pressure, SpO2 and ECG. BIS also required when Propofol is used. Prepare an emergency cart during treatment.
	<b>Electrosurgical unit</b>			<b>ESG-100</b> (Olympus Medical Systems)
Marking	Device	Caution		Setting
	Needle knife	When using the needle knife in marking, be careful never to apply the tip to mucosa with too much force. Always apply the needle tip to the mucosa gently.		ForcedCoag1 20W
Local injection	Epinephrine	Indigo carmine		
	Saline	Used (10,000X dilution)	Used	Advantage: Low price Disadvantage: None
	Sodium hyaluronate	Used (10,000X dilution)	Used	Advantage: Sustained bulging supports safer precutting Disadvantage: Bubble production, too much elevation
Apply injection to the submucosal layer just above the proper muscle layer where there is sparsest connective tissue.				
Precutting & mucosal incision	Device	Caution		Setting
	Precutting: Needle knife	For easier dissection, necessary to make the circumferential incision at a uniform depth. Thus, precutting should be deep enough just above the fascia. Place it at the 12 o'clock position for letting ITknife2 move from far to close in incising. Also perform additional precutting at 6 o'clock position for the case when mucosal incision in the horizontal dissection is difficult. In mucosal incision, also use a needle knife after lifting with sufficient local injection when horizontal operation is difficult or scar is severe.		PulseCut slow 40W
	Mucosal incision: ITknife2, Needle knife			PulseCut slow 40W
Submucosal dissection	Device	Caution	Countertraction	Setting
	ITknife2, Needle knife	Use the sheath of ITknife2 like the guidewire by moving it along the ulcer floor. This keeps the depth of dissected plane uniform. If the dissected layer contains many vessels, use the ForcedCoag2 mode. The knife should be moved slowly when haemostasis is prioritised and comparatively quickly when cutting is prioritised. Always be sure to hold the endoscope firmly with the right hand to prepare for any unexpected movement or sudden respiratory movement. For a scar lesion, delicate dot-cutting by a needle knife is more effective than a line-cutting of ITknife2. In this case, to secure the endoscope is necessary. When performing local injection, create an easy-to-manipulate lifting just above the muscle layer of the sparse tissue.	<ul style="list-style-type: none"> <li>Secure the field of view with a distal attachment.</li> <li>Always consider the direction of gravity when determining the mucosal incision and dissection directions.</li> </ul>	ForcedCoag2 50W PulseCut slow 40W
Haemostasis	Device	Caution	Other	Setting
	ITknife2	Venous bleeding (If bleeding cannot be stopped, switch to the haemostatic forceps before carbonisation occurs.)	Perform reliable haemostasis for each bleeding. Avoid contact with the muscle layer as much as possible. Even an expert spends 70% of the total ESD operation time on haemostasis. Keep in mind that the person who masters haemostasis is the one who masters ESD.	ForcedCoag2 50W
	Haemostatic forceps	Arterial bleeding: Before coagulating, grasp the bleeding point and confirm that bleeding has stopped. Avoid insufficient haemostasis because this simply leads to useless carbonisation of tissues and makes effective haemostasis and incision difficult.		SoftCoag 80W
Preventive haemostasis	Device	Caution		Setting
	ITknife2	Small vessels are to be coagulated directly with ITknife2.		ForcedCoag2 50W
	Haemostatic forceps	If the bleeding vessel is large, grasp it firmly with haemostatic forceps and perform haemostasis surely.		SoftCoag 80W
Perforation measure	Method	Timing	Tip	
	Clip suture	Depends on the size and insufflation condition. If allowed, perform clipping after getting enough space for not disturbing the dissection. In certain cases, perform deaeration by puncture (using a 16G argyle needle with side cavity) before clip suture to prevent abdominal compartment syndrome.	The perforation made under cautious operation has a diameter of only 1 or 2 mm, which can be sutured with a single clip. A larger perforation should be sutured sequentially from one end.	

\* May not be available in your area.

Information as of October 1, 2009.





# ITknife2

Model **KD-611L**

**Dr. Hiroyuki Ono**  
Shizuoka Cancer Center

## Interview With The Expert

**Q.** What are the advantages of ITknife2?

**A.** There is a clear improvement in cutting performance in lateral cutting and fibroid areas. It facilitates incision and dissection in total while maintaining the advantages of the conventional ITknife. The incision and dissection speeds have also been increased even more.

**Q.** Are any procedures or precautions different from the conventional ITknife?

**A.** You can feel the difference in cutting performance by using the knife in the same way with ITknife. However, you have to keep in mind that ITknife2 is quite a bit sharper. If you make the same kind of strokes you're used to with ITknife, you may cut too deeply and increase the risk of perforation. You should be careful with the knife until you get used to it. It's also a good idea to use the EndoCut mode. Or step on the high-frequency switch intermittently with a continuous wave mode, to prevent ITknife2 from slipping and causing a perforation. In addition, as with ITknife, laying the knife down too much increases the risk of perforation, so ITknife2's sheath should be held slightly to upright direction than ITknife. Remember to be careful to avoid problems in the initial introductory phase. However, you won't need to think about these points once you've gotten used to ITknife2 after several uses.

**Q.** Are there any weak points of ITknife2?

**A.** Although the cutting performance is better than ITknife, a certain degree of skill is required when working on sites where the knife needs to approach perpendicularly. In such a case, point the insulated tip straight toward the muscle layer and swing laterally by manipulating the endoscope or using the angulation function to cut the site little by little.

**Q.** Under what conditions do you use other devices?

**A.** Since I started using ITknife2, I have rarely needed to use a needle knife. However, a needle knife offers better cutting performance when an ulcer scar is very hard. In such a case, I use a needle knife until the mucosa is curled up in a certain amount and then I switch to ITknife2.

## Applicability of ITknife2

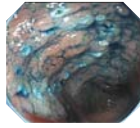
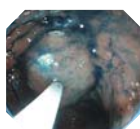
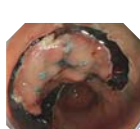

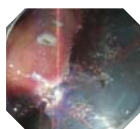
### Difficulty per region

○: Easy. No mark: Ordinary. △: Difficult.

Region	Difficulty	Region	Difficulty	Region	Difficulty
Cardiac region		Posterior wall of upper body		Lesser curvature of lower body	
Fornix	△	Lesser curvature of middle body		Greater curvature of lower body	
Lesser curvature of upper body		Greater curvature of middle body		Anterior wall of lower body	
Greater curvature of upper body	△	Anterior wall of middle body		Posterior wall of lower body	
Anterior wall of upper body		Posterior wall of middle body		Pyloric ring	△

**Note for beginners:** It is recommended to start a trial procedure on a minor lesion in the anterior or posterior wall in the antrum or in the greater curvature. If the endoscope cannot approach the lesion in the lesser curvature of the lower body, it is recommended that you use a multi-bending endoscope.

\*Multi-bending endoscope is not available in some areas.

	Intravenous anaesthesia	Premedication	General anaesthesia	Monitoring
<b>Sedation</b>	Opistan (pethidine hydrochloride)*, cercine (diazepam)*, midazolam	Not used	Not used	SpO2, ECG, blood pressure, ETCO2, BIS
	<b>Electrosurgical unit</b>			<b>VIO-300D</b> (Erbe) <b>ICC-200</b> (Erbe) <b>ESG-100</b> (Olympus Medical Systems)
<b>Marking</b>	 <b>Device</b> APC probe	<b>Caution</b> It causes little bleeding in marking and can leave clear marks.		<b>Setting</b> Forced APC Flow1.8L/min 20W    APC Flow1.8L/min 20W
<b>Local injection</b>	 <b>Device</b> Glyceol (concentrated glycerin fructose)* + MucoUp (sodium hyaluronate)*	<b>Epinephrine</b> Used (400X dilution)	<b>Indigo carmine</b> Used Appropriate amount	<b>Advantage:</b> Long lifting time <b>Disadvantage:</b> Bubbles during incision <small>Mix equal amount of Glyceol and MucoUp. Identification of the submucosal layer can be facilitated by submucosal dyeing using indigo carmine. Pale dyeing is applied.</small>
<b>Circumferential incision</b>	 <b>Device</b> Precutting: Needle knife Circumferential incision: ITknife2	<b>Caution</b> Since ITknife2 cuts very well, the cut duration can be 1 when cutting a thin wall in the EndoCut mode. Circumferential incision is possible with the setting for precutting. If bleeding is noticeable, set to SwiftCoag, Effect 5, 60 W.		<b>Setting</b> DryCut 50W Effect4    AutoCut 60W Effect3    PulseCut fast 60W EndoCut Q Effect2 Cut duration 2 Cut interval 2    EndoCut 80W Effect3    PulseCut fast 60W
<b>Submucosal dissection</b>	 <b>Device</b> ITknife2	<b>Caution</b> Use the SwiftCoag mode mainly. If coagulation is too strong, the EndoCut mode can also be used.	<b>Countertraction</b> By twisting the endoscope or using a distal attachment.	<b>Setting</b> EndoCut Q Effect2 Cut duration 2 Cut interval 2    EndoCut 80W Effect3    PulseCut fast 60W SwiftCoag 60W Effect5    Forced 50W    ForcedCoag2 50W
<b>Haemostasis</b>	 <b>Device</b> ITknife2 Hot biopsy forceps	<b>Caution</b> Begin haemostasis with ITknife2. Switch to this device when haemostasis with ITknife2 is difficult.		<b>Setting</b> SwiftCoag 60W Effect5    Forced 50W    ForcedCoag2 50W SoftCoag 80W Effect6    SoftCoag 80W    SoftCoag 80W
<b>Preventive haemostasis</b>	Large vessels should be coagulated using hot biopsy forceps in advance. When the vessels are plentiful and bleeding is expected, use the SoftCoag mode, move ITknife2 slowly and bring both effects of cutting and coagulation simultaneously.			
<b>Perforation measure</b>	<b>Method</b> Applying a clip. Prevent blind operation by avoiding bleeding and securing the field of view.	<b>Timing</b> Immediately after perforation if possible. Alternatively, when clips will not come in the way after dissection has been advanced.	<b>Tip</b> With a small perforation, make the ulcer floors approximate. If large, patching with omentum is easier.	

\* May not be available in your area.

Information as of October 1, 2009.



# HookKnife

Model **KD-620LR**

**Dr. Tsuneo Oyama**

Saku Central Hospital

## Interview With The Expert

**Q.** What are the advantages of HookKnife?

**A.** Above all, it's safer than a needle knife because it hooks the mucosa for incision and dissection so it is less invasive for the deeper tissues. The rotary function provides another advantage, the ability to align the knife horizontally or vertically. Marking with the back of HookKnife will reduce the risk of perforation. In addition, safer use is possible by mounting an attachment to the endoscope's distal end to maintain the field of view and by pulling the mucosa into the attachment before supplying current. The capability to perform dissection by directly observing the submucosal layer enables precoagulation. It is nice to be able to perform dissection with a good view and no bleeding.

**Q.** Are there any weak points of HookKnife?

**A.** Due to the fact that the hook length is 1.3 mm long, it is unavoidable to say that the cutting amount for each time is not plentiful.

**Q.** Under what circumstances do you also use other devices?

**A.** I use a needle knife for circumferential incision. The needle knife is convenient because its cutting style is like flicking the tissue. Also ITknife and FlexKnife have a higher vertical incision speed so I sometimes use them instead of HookKnife.

## Applicability of HookKnife

### Difficulty per region

○: Easy. No mark: Ordinary. △: Difficult.

Region	Difficulty	Region	Difficulty	Region	Difficulty
Cardiac region		Posterior wall of upper body		Lesser curvature of lower body	○
Fornix	△	Lesser curvature of middle body	○	Greater curvature of lower body	○
Lesser curvature of upper body	○	Greater curvature of middle body	△	Anterior wall of lower body	○
Greater curvature of upper body	△	Anterior wall of middle body		Posterior wall of lower body	○
Anterior wall of upper body		Posterior wall of middle body		Lesser curvature of anterior wall	
				Greater curvature of antrum	○
				Anterior wall of antrum	○
				Posterior wall of antrum	○
				Pyloric ring	△

**Recommendation for beginners:** 1) It is important to begin by observing the experts' procedures. 2) Start with UL(-) lesion of 2 cm or less. 3) After you experience about 10 cases, observe procedures performed by experts again.

	Sedation					
	Intravenous anaesthesia	Premedication	General anaesthesia	Monitoring		
	Used	Midazolam 5 to 7.5 mg + Butorphanol 0.5 mg	Recommended for a large lesion, a case with scar or a case in the neck region of oesophagus.	Used		
	<b>Electrosurgical unit</b>					
			<b>VIO-300D</b> (Erbe)	<b>ICC-200</b> (Erbe)		
				<b>ESG-100</b> (Olympus Medical Systems)		
Marking	Device	Caution		Setting		
	HookKnife (Use the back of the hook part.)	Make HookKnife retracted to reduce the risk of perforation.		Oesophagus: SoftCoag 20W Effect4 Stomach: ForcedCoag 40W Effect2	Oesophagus: SoftCoag 40W Stomach: Forced 40W	Stomach: ForcedCoag1 30W
Local Injection		<b>Epinephrine</b>	<b>Indigo carmine</b>			
	Glyceol (concentrated glycerin fructose)*	Used	Not used	Oesophagus: 200X dilution / Stomach: 20X dilution. Relatively long lifting time (equivalent to 20% glucose)		
	Sodium hyaluronate	Used	Not used	Strongest retention force.		
	The muscle layer is a white cloudy thick wall, while the submucosal layer is transparent. Therefore, the two layers are easy to distinguish. The vessels in the submucosal layer can be observed more transparently when indigo carmine is not used. Also, it dies the incised sample in blue.					
Circumferential Incision	Device	Caution		Setting		
	HookKnife	As the EndoCut mode cuts tissue a little at a time, a serious mistake does not happen even when knife control is inadequate. AutoCut mode cuts tissue more sharply with less thermal denaturation.		Oesophagus: SprayCoag 60W Effect2 or EndoCut 1 Effect2 Duration2 Interval2 Stomach: DryCut 60W Effect5 or SwiftCoag 60W Effect 3	Beginner: EndoCut 120W Effect 3 Expert: AutoCut 120W Effect3	Stomach: ForcedCoag2 15W
Submucosal dissection	Device	Caution	Countertraction	Setting		
	HookKnife	Use the hook part to approach perpendicularly toward the proper muscle layer. Use the arm part if approaching in parallel is allowed.	Use distal attachment (D-201). With distal attachment, dissection by suction technique is possible in the oesophagus. A clip with attached thread can also be used.	Oesophagus, stomach: SprayCoag 60W Effect 2 or EndoCut 1 Effect2 Duration2 Interval1	Forced 60W APC mode 60W	ForcedCoag2 10 to 15W
Haemostasis	Device	Caution		Setting		
	HookKnife	Approach the back of the knife to the bleeding point and briefly supply current without contact. With ESG-100, avoid using ForcedCoag mode only. Instead, perform pre-coagulation in the SoftCoag mode before cutting in the ForcedCoag mode to prevent bleeding.		SprayCoag 60W Effect2	APCmode 60W	SoftCoag 60W ForcedCoag2 15W
	Coagrasper	If bleeding continues, the grasped position may be inappropriate. It is important to try grasping a different position.		SoftCoag 80W Effect5	SoftCoag 80W	SoftCoag 60W
Preventive haemostasis	Device	Caution				
	HookKnife	Small vessel about 1 mm: Hook and coagulate in the Spray or APC mode.				
	Coagrasper	Large vessel about 2 mm: Grasp with Coagrasper and supply current for 1 or 2 seconds in the SoftCoag mode.				
Perforation measure	Method	Timing		Tip		
	Clip suture	Dissect to some extent before clipping to prevent the clip from interfering with subsequent treatment.		Perforation made by HookKnife is about 1 × 3 mm small. A single clip can suture it and air leak is low.		

\* May not be available in your area.

Information as of October 1, 2009.



# DualKnife

Model **KD-650L**

**Dr. Naohisa Yahagi**

Keio University

## Interview With The Expert

### Q. What are the advantages of DualKnife?

**A.** DualKnife is an improvement over FlexKnife that offers safer and easier use while it continuously provides all the benefits of FlexKnife. DualKnife can be set to either of two lengths. When the knife is extended to maximum length, it can be used for incision and dissection. When the knife is retracted, the knife tip still protrudes by 0.3 mm so it can be used for marking as well as simple haemostasis. The knife length can be set to either 2 mm or 1.5 mm. The 2 mm length is for gastric ESD, while the 1.5 mm length is for oesophageal ESD. The knife tip has a projecting section, which catches the tissue during incision and dissection, considerably improving knife manoeuvrability. Moreover, the dome-shaped knife tip improves the knife contact during incision and dissection. In addition, the outer diameter of the sheath is just 2 mm, so smooth water and smoke suction is possible even when the knife is retracted in the instrument channel.

### Q. What are the differences between FlexKnife and DualKnife in terms of operation and precautions?

**A.** The basic procedures are identical, but the thin, needle-shaped design of DualKnife provides superior incision performance. Consequently, physicians typically set DualKnife's high-frequency power about 10 W lower than FlexKnife. In addition, burnt tissue does not get attached to DualKnife compared to FlexKnife. Even when residue is adhered to the tip, it can be removed by moving the knife back and forth a few times and allows continuous use. While FlexKnife needs fine adjustment for knife length, DualKnife can accurately set the knife length into two lengths. This also makes it easier for the operation assistant to handle.

### Q. Are there any weak points of DualKnife?

**A.** The knife is short so it cannot incise unless the knife is brought in contact optimally. The thinness of the sheath could make it more difficult to transmit force to the tip when the sheath is extended. It is more effective to use the multi-bending endoscope when treating a lesion in a hard-to-approach region.

### Q. Under what circumstances would you also use another device?

**A.** Though not as frequently as when I used FlexKnife, I sometimes switch to HookKnife when I encounter advanced fibrosis during dissection, limited space for endoscope manoeuvre, or unstable knife contact due to severe respiratory movements. Haemostasis for small amount of bleeding can generally be achieved by bringing the retracted knife in contact for coagulation. For pulsatile bleeding, I use Coagrasper.

## Applicability of DualKnife

### Difficulty per region

○: Easy. No mark: Ordinary. △: Difficult.

Region	Difficulty	Notes	Region	Difficulty	Notes
Cardiac region	△		Posterior wall of upper body	△	Tends to bleed heavily.
Fornix	△		Lesser curvature of middle body	○	
Lesser curvature of upper body			Greater curvature of middle body	△	Bleeding makes a pool of blood.
Greater curvature of upper body	△	Bleeding makes a pool of blood.	Anterior wall of middle body	△	
Anterior wall of upper body	△		Posterior wall of middle body		
			Lesser curvature of lower body		
			Greater curvature of lower body		
			Anterior wall of antrum	○	
			Posterior wall of antrum	○	
			Pyloric ring	△	

When gastric angulus widens, distance is made between the device and mucosa and it is difficult to transmit proper force. Multi-bending endoscope enables easy operation.

Sedation	Intravenous anaesthesia	Premedication	General anaesthesia	Monitoring
	Less than 2 hours	Pethidine hydrochloride 35 mg + Cercine (diazepam)* 5 to 10 mg (appropriate amount)	More than 2 hours	All cases: SpO2, blood pressure
<b>Electrosurgical unit</b>				VIO-300D (Erbe)   ESG-100 (Olympus Medical Systems)
Marking	Device	Caution		Setting
	DualKnife	Retract the knife.		SoftCoag 50W Effect4   SoftCoag 50W
Local Injection		Epinephrine	Indigo carmine	
	Glyceol (concentrated glycerin fructose)*	Used (10,000X dilution)	Used	Low price enables to use Glyceol without concerning the quantity. Minimal tissue damage allows worry-free usage.
	MucoUp (sodium hyaluronate)*	Used (10,000X dilution)	Used	Convenient when lifting is insufficient with Glyceol due to good lifting retention. High price.
Add indigo carmine which dyes the vessels in light blue. Dyed with indigo carmine, the submucosal layer can easily be identified even when the tissue is burnt.				
Circumferential incision	Device	Caution		Setting
	DualKnife	Do not perform circumferential incision. Incise only the part to be dissected and dissect immediately.		Stomach: DryCut 30W Effect 3   Oesophagus: DryCut 30W Effect 2   ForcedCoag2 30W or PulseCut slow 30W
Submucosal dissection	Device	Caution	Countertraction	Setting
	DualKnife	Move the knife slowly when dissecting small vessels.	Usually use a distal attachment. Also, use gravity to lift up the dissected mucosa.	SwiftCoag, 40W Effect4   ForcedCoag2 30W
Haemostasis	Device	Caution		Setting
	DualKnife	For venous bleeding, contact the bleeding point with the retracted knife and supply current for a very short period.		SwiftCoag, 40W Effect4   ForcedCoag2 30W
	Coagrasper	For arterial bleeding, use Coagrasper.		SoftCoag 50W Effect4   SoftCoag 50W
Apply the auxiliary water jet function to confirm the bleeding point.				
Preventive haemostasis	Small vessels: Use the SwiftCoag mode and cut by moving the knife slowly. Large vessels: Use haemostatic forceps in the SoftCoag mode. Grasp the vessel, lift it up slightly and supply current.			
Perforation measure	Method	Timing	Tip	
	Clip suture.	After finding a perforation, perform additional dissection to create a margin and then attach a clip.	After placing a clip, exhaust air slightly to remove the tension of the muscle layer before closing.	

\* May not be available in your area.

Information as of October 1, 2009.





# TriangleTipKnife

Model **KD-640L**

**Dr. Haruhiro Inoue / Dr. Hitomi Minami /  
Dr. Yoshitaka Sato**

Showa University Northern Yokohama Hospital

## Interview With The Expert

**Q.** What are the advantages of TriangleTipKnife?

**A.** First, it does not need any kind of axis alignment. It can hook effectively in any direction. Also, by discharging spray coagulation, the submucosal layer will be dissected without any contact of the knife.

**Q.** Are there any weak points of TriangleTipKnife?

**A.** When there is serious fibrosis in submucosal dissection, it is better to use a hook because it has a thinner distal end than TriangleTipKnife.

**Q.** Under what conditions do you use other devices as well?

**A.** If the dissected part of the mucosa starts dangling when you are about to resect, it's easier to complete the procedure using ITknife.

## Applicability of TriangleTipKnife

### Difficulty per region

○: Easy. No mark: Ordinary. △: Difficult. ▲: Very difficult.

Region	Difficulty	Region	Difficulty	Region	Difficulty	Region	Difficulty
Cardiac region	△	Posterior wall of upper body	△	Lesser curvature of lower body		Greater curvature of antrum	○
Fornix	▲	Lesser curvature of middle body		Greater curvature of lower body		Anterior wall of antrum	○
Lesser curvature of upper body		Greater curvature of middle body		Anterior wall of lower body		Posterior wall of antrum	○
Greater curvature of upper body	△	Anterior wall of middle body		Posterior wall of lower body	△	Pyloric ring	
Anterior wall of upper body		Posterior wall of middle body	△	Lesser curvature of anterior wall	○		

**Note for beginners:** The most difficult regions are the upper part and posterior wall side of the stomach.

Sedation	Intravenous anaesthesia	Premedication	General anaesthesia	Monitoring
	Opistan (pethidine hydrochloride)* 35 mg + Horizon (diazepam)* 10 mg + Dormicum (midazolam)* Appropriately	Buscopan, (scopolamine butylbromide)* 1 ampule	Perform the procedures in the operating room under general anaesthesia when it is expected to take more than two hours.	SpO2, ECG and blood pressure are monitored in all cases.

Marking	Device	Caution	Electrosurgical unit	
			VIO-300D (Erbe)	ESG-100 (Olympus Medical Systems)
	TriangleTip Knife	Retract the knife and gently contact it to the mucosa and briefly supply current.	SprayCoag 60W Effect1	ForcedCoag1 20W

Local injection	Epinephrine		Indigo carmine	Advantage: Low price Disadvantage: Short lifting time
	Used 1 ampule per 200 ml	Used (appropriate amount)		
	Glyceol (concentrated glycerin fructose)*	Used 1 ampule per 200 ml	Used (appropriate amount)	
	Sodium hyaluronate	Not used	Used	Advantage: Long lifting time Disadvantage: High price

Use saline in circumferential incision. For submucosal dissection, use hyaluronic acid to reserve the view with sufficient bulging, and perform dissection with the knife tip.

Circumferential incision	Device	Caution	Setting	
			EndoCutQ Effect 2 Cut duration1 Cut interval6	PulseCut slow 20W
	TriangleTip Knife	For precutting, gently apply the triangular tip to the mucosa and briefly supply current in the EndoCut or PulseCut mode. Once the muscularis mucosae have been cut and the submucosal layer is exposed, advance the mucosal incision along the depth. For circumferential incision, hook the tip while applying tension to the mucosa using an attachment and supply current for further incision. For the tip to hook properly, be sure to supply sufficient tension.	●EndoCutQ Effect 2 Cut duration1 Cut interval6	●DryCut 50W Effect3

Submucosal dissection	Device	Caution	Setting	
			SprayCoag 60W Effect1	ForcedCoag2 60W
	TriangleTip Knife	Slide the endoscope into the submucosal layer using the attachment to apply tension. Then supply current while directly confirming the target. Avoid hooking the muscle layer during output. Use sodium hyaluronate for local injection.	SprayCoag 60W Effect1	ForcedCoag2 60W

Haemostasis	Device	Caution	Setting	
			SprayCoag 60W Effect 1	ForcedCoag2 60W
	TriangleTip Knife	For spurting type of bleeding, contact the knife tip to the bleeding point for coagulation. Also effective to do haemostasis by contacting the retracted knife tip to the bleeding point.	SprayCoag 60W Effect 1	ForcedCoag2 60W
	Coagrasper	If haemostasis using the tip of TriangleTipKnife is difficult, use Coagrasper to grasp the bleeding point and supply current for 2 or 3 seconds in the SoftCoag mode. It is important to confirm the bleeding point to grasp it accurately.	SoftCoag 80W Effect5	SoftCoag 80W

Preventive haemostasis	Device	Caution	Setting	
			SprayCoag 60W Effect1	ForcedCoag2 60W
	TriangleTip Knife	Coagulate the visible vessels in advance. Small vessels can be cauterised by performing coagulation with the tip of TriangleTipKnife. For large vessels, use Coagrasper to grasp and cauterise in SoftCoag mode.	SprayCoag 60W Effect1	ForcedCoag2 60W
	Coagrasper		SoftCoag 80W Effect5	SoftCoag 80W

Perforation measure	Method		Timing	
		A small perforation with a size of pinhole is to be obstructed with a clip for conservative treatment.		The basic is to obstruct the hole with a clip immediately after perforation. If clipping is difficult, it is sometimes recommended to incise or dissect a little further and retry clipping.

\* May not be available in your area.

Information as of October 1, 2009.



# Support Devices

**Coagrasper** Model FD-410LR  
**HotClaw** Model FD-420LR  
**HotBite** Model FD-430L

**Dr. Toshihiko Doi**  
 National Cancer Center Hospital East

## Interview With The Expert

**Q.** What are the advantages of the devices you invented?

**A.** You only need to have standard biopsy techniques to use the support devices. They minimise bleeding and are all designed with full consideration for safety. HotClaw is suitable for connecting the incised parts or when approach with ITknife is difficult. HotBite and Coagrasper are support devices for ESD procedure and should be used when required during it.

**Q.** Do you have any weak points for the devices you invented?

**A.** In principle, these devices can be used in any position in which biopsy is possible. However, in positions where biopsy is difficult (where forceps should be positioned in the tangential direction), inevitably these devices are also difficult to use. In addition, cutting regions with strong fibrosis may be difficult. Due to the fact that, in present, coagulation results in strong degradation and electro-surgical systems have not yet been improved, these devices should be used as support devices. On the contrary, ITknife can cut those difficult positions mentioned above more easily and safely. For speedy cutting in the vertical position, ITknife will be the best. Please be noted, with any of these devices, grasping too much mucosa will lead to dropping the electrical resistance and adequate cauterisation may become difficult even if the current is supplied.

**Q.** Under what circumstances do you also use other devices?

**A.** At present, I employ the two devices (HotBite and Coagrasper) in almost all ESD procedures. For vertical cutting, ITknife is faster so I generally use it. I use other devices as support devices for now, but I believe ITknife has the lowest electrical risk. Using the appropriate device for a specific purpose is important, but there are affinities for each device, just like there are surgeons who are good at using Cooper, surgeons who are good at using an electro-surgical knife, etc. Select the device you use not from "rumours" but from the viewpoint of radical curability and safety.

## Applicability of the Support Devices

### Difficulty per region

○: Easy. No mark: Ordinary. △: Difficult.

Region	Difficulty	Facilitation	Notes
Cardiac region	△	To facilitate, use a hood after circumferential incision.	Facilitated by using 2CH endoscope. Control bleeding.
Fornix	△	Distance from the endoscope is a problem	Mainly use HotClaw to facilitate. Strip biopsy can be applied after circumferential incision.
Lesser curvature of upper body	△	Shallow circumferential incision is recommended	Facilitated by using 2CH endoscope.
Greater curvature of upper body	△	Ease the procedure by mainly using HotClaw.	HotClaw can be used on the anal side.
Anterior wall of upper body	△	Use 2CH endoscope to facilitate.	Can also be slightly retroflexed in the antrum.

**Note for beginners:** These devices are basically recommended for circumferential incision of a 30-mm (or less) differentiated carcinoma with preoperative diagnosis of m/ul (-). The operator must know another method besides ESD to complete the treatment in case continuing of ESD (haemostasis, dissection, and incision) becomes unmanageable. If the curability is expected to be lower than that of piecemeal resection, do not attempt to perform ESD. Use of HotBite to make holes and HotClaw to connect the holes, and the cutting the rest with ITknife are welcomed for beginners. Beginners should start with lesions that do not require dissection after circumferential incision. Keep in mind that ESD is an experimental medical procedure and patients' curability as well as safety should be fully considered.

Sedation	Intravenous anaesthesia	Premedication	General anaesthesia	Monitoring
	Not used in principle (Should always be under supervision of an anaesthesiologist.)	Buscopan (scopolamine butylbromide)* or Dormicum (midazolam)*: As required. Opistan (pethidine hydrochloride)* + Dormicum: As required.	Not used in principle (Should always be under supervision of an anaesthesiologist.)	Used with all cases
	<b>Electrosurgical unit</b>			ICC-200 (Erbe) PSD-60 (Olympus Medical Systems)
Marking	Device	Caution		Setting
	HotBite or Needle knife	HotBite: Use the distal end in the same way as coagulation probe. Low risk of perforation.		Forced 35W Forced 35W Effect1
Local injection		Epinephrine	Indigo carmine	
	Saline	Used (1 ampule per 100 cc)	Used	Merit: Approved by Japanese insurance system. Demerit: Short duration.
	Mannitol	Used (0.5 ampule per 100 cc)	Used	When lifting the submucosal layer is difficult.
	Use of indigo: Recommended in principle.			
Precutting	Device	Caution		Setting
	HotBite			AutCut 120W Effect3 AutCut 120W Effect5~6
	Needle knife			AutCut 120W Effect3 AutCut 120W Effect4
Circumferential incision	Device	Caution		Setting
	ITknife	Pulling cut direction (2CH endoscope: An appropriate biopsy port should be used): Extremely quick, stable incision. Bleeding can be reduced by maintaining the depth of HotBite.		EndoCut 120W Effect3 EndoCut 120W Effect3
	HotClaw	Same manipulation as biopsy. Cutting in the lateral direction with respect to the endoscope axis. Suitable for beginners.		AutoCut 120W Effect3 AutoCut 120W Effect5~8
Submucosal dissection	Device	Caution	Countertraction	Setting
	ITknife	Coagulation performance is quite stable thanks to "ITknife's line contact with tissue." *A HotBite may also be used with scarring, etc.	Use a 2CH endoscope. Use a distal attachment and hood.	EndoCut 120W Effect3 EndoCut 120W Effect3
	HotClaw			AutoCut 120W Effect3 AutoCut 120W Effect5~8
Haemostasis	Device	Caution		Setting
	ITknife	Just supply Coag current during the incision or dissection.		Forced 40W Forced 40W Effect1
	Coagrasper	2 to 3 sec. current supply.		SoftCoag 50W SoftCoag 50W Effect4~5 Forced 40W Forced 40W Effect1
Preventive haemostatic	Haemostatic forceps: Spurting from vein—Current supply with distal end only (Forced 40W). Vein: SoftCoag 60 to 50W. Artery: SoftCoag 40W. Arterial bleeding: SoftCoag 60 to 50W. If this cannot stop bleeding, add Forced 40W for a few seconds. *The Forced mode enables instant haemostasis. Please be careful because the haemostatic ability becomes lower for the carbonised tissue. Supply SoftCoag current in several times, intermittently. If the patient has high blood pressure, control it to the normal range. If the water jet function is not available, use an irrigation tube on a 2CH endoscope. If bleeding cannot be stopped at all, use a clip and supply current.			
Perforation measure	Method	Timing	Tip	
	Clipping (Ligating snare can also be used together.)	Immediately after finding perforation.	Discontinue the procedure if required and start over the next day.	

\* May not be available in your area.

Information as of October 1, 2005.