



TeXture and color enhancement Imaging-assisted precutting: 3 case reports

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Backgrounds and Aims: In ERCP, precutting is used when biliary cannulation is challenging. Precutting is a high-risk procedure that can lead to adverse events. TeXture and color enhancement Imaging (TXI) enhances texture, brightness, and color to define subtle tissue differences clearly and may be helpful in precutting. Nevertheless, there are limited video case reports demonstrating precutting using TXI. Here, we review the techniques of TXI-assisted precutting.

Methods: This video article describes TXI-assisted precutting in 3 patients with obstructive jaundice resulting from cancer of the pancreatic head. The existing literature on TXI for biliopancreatic endoscopy also is reviewed.

Results: In all cases, TXI helped in biliary cannulation using precutting. No adverse events were observed in any of the cases.

Conclusions: Despite the roughness of the precut incision surface, TXI was found to improve visibility and significantly helped achieve biliary cannulation. (VideoGIE 2024;9:536-40.)

INTRODUCTION

In ERCP, precutting is used when biliary cannulation is challenging.¹ Precutting is a high-risk procedure that can lead to adverse events. TeXture and color enhancement Imaging (TXI) enhances texture, brightness, and color to define subtle tissue differences clearly.² Nevertheless, there are limited video case reports demonstrating precutting using TXI. This video article discusses TXI-assisted precutting in 3 patients with obstructive jaundice resulting from cancer of the pancreatic head (Video 1, available online at www.videogie.org).

TEXTURE AND COLOR ENHANCEMENT IMAGING

TXI is an image-processing technique used to optimize the 3 elements of white-light imaging (WLI): brightness, texture, and color tone. TXI involves the following processes: (1)

The input image is divided into a texture image and a base image. (2) Brightness in the dark regions of the base image is corrected (brightness enhancement). (3) The texture image is enhanced. (4) The compressed base image and the enhanced texture image are recombined to create a TXI image for immediate display as TXI mode 2. (5) TXI mode 1 is generated by adding color enhancement to the TXI mode 2 image. TXI mode 1 is designed to highlight differences in hues between red and white. There are 2 settings for TXI: mode 1, with color enhancement, and mode 2, without color enhancement, which has an appearance closer to WLI color tone² (Fig. 1). Switching from WLI to TXI during endoscopy is straightforward and can be done using the touch panel on the EVIS X1 (Olympus Marketing, Tokyo, Japan; Fig. 2).

TXI FOR BILIOPANCREATIC ENDOSCOPY

TXI uses the aforementioned mechanism to reduce halation while brightening and enhancing the field of view, making it easier to visualize surface structures and subtle changes in color tone. Because of this feature, TXI is valuable for lesion detection in GI diseases, as documented in numerous studies. However, there are limited reports on the effectiveness of TXI in the pancreaticobiliary field.

In a review of image-enhanced endoscopy in the pancreaticobiliary field, Toyonaga et al³ summarized the reports on TXI. Miyaguchi et al⁴ found that TXI mode 1 can enhance papillary recognition by trainees who are inexperienced in ERCP.

Abbreviations: TXI, TeXture and color enhancement Imaging; WLI, white-light imaging.

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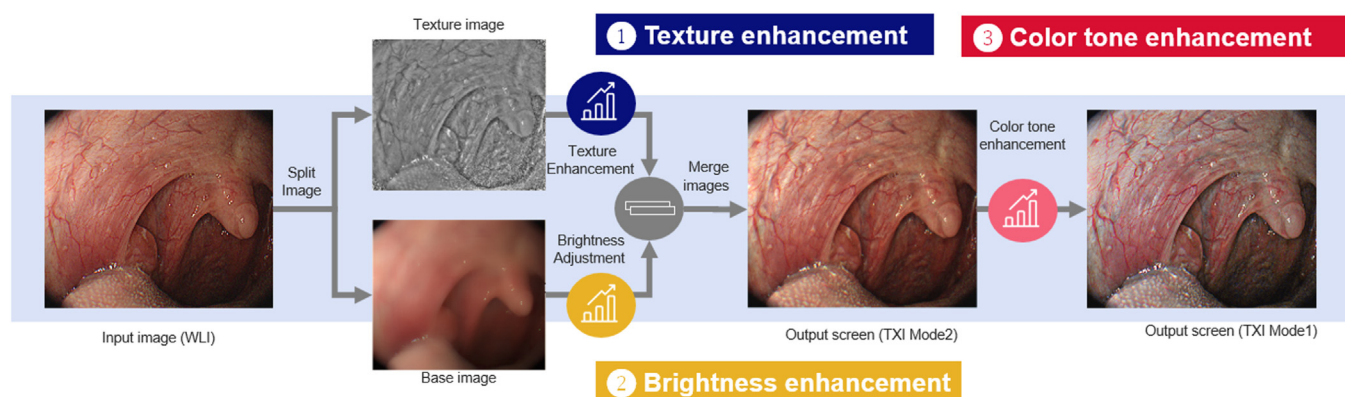


Figure 1. Main mechanism of TeXture and color enhancement Imaging (Courtesy of Olympus Marketing).



Figure 2. Olympus EVIS X1.

Toyonaga et al,⁵ Tanisaka et al,⁶ and Takenaka et al⁷ have reported that TXI was helpful in identifying difficult choledochojejunal and pancreaticojejunal anastomotic strictures.

TXI also could be useful for ampullary tumors. Toyonaga et al⁸ and Tanisaka et al⁹ have reported that TXI also was useful for identifying the biliary and pancreatic duct orifices on the incision surface after EP. Toyonaga et al⁸ reported that TXI was useful for assessing the extent of lateral extension of papillary tumors by improving visibility.

TXI also may be useful for hemostasis in post-EST bleeding. Red dichromatic imaging has been reported to help visualize the bleeding site in darker yellow in patients with active bleeding after sphincterotomy¹⁰; however, it was ineffective when the bleeding was not visible. Tanisaka et al¹¹ reported a successful case of clipping hemostasis for spontaneously he-

mostatic postendoscopic sphincterotomy hemorrhage by identifying a visible vessel using TXI. Other reports on the usefulness of TXI in identifying minor papilla orifice¹² and peroral cholangioscopy¹³ have been published.

TXI FOR PRECUTTING

Toyonaga et al¹⁴ reported a case in which the bile duct orifice was clearly visible and useful for cannulation by using TXI during precutting, using video, and they recently published a retrospective observational study that demonstrated the effectiveness of TXI mode 2 in identifying the biliary orifice after needle knife precut papillotomy.¹⁵

Although the precut incision surface is often rough, TXI improves visibility and may aid in precutting. However, to

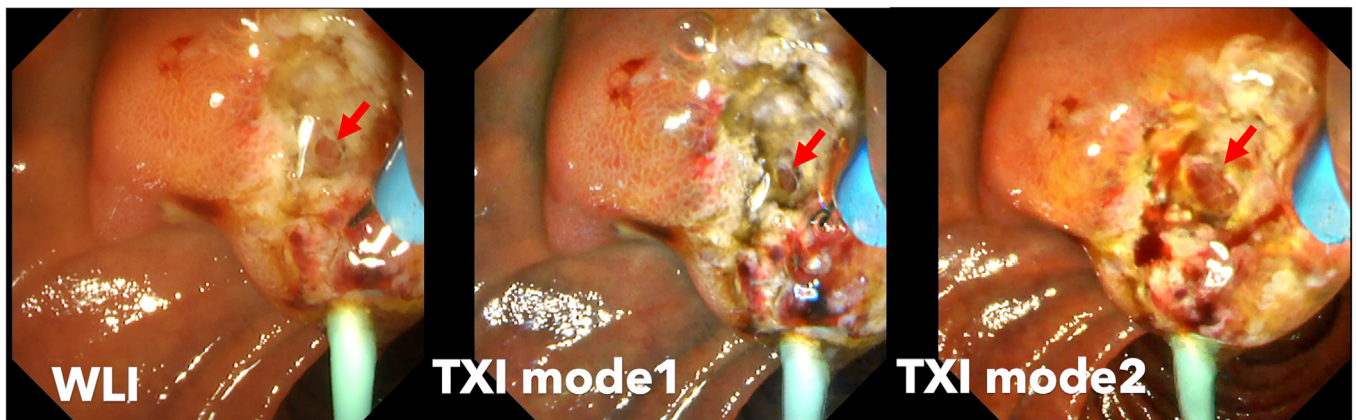


Figure 3. Compared with WLI, both TXI mode 1 and mode 2 help visualize the incision surface more clearly. TXI mode 1 enhances texture, brightness, and color, whereas mode 2 enhances texture and brightness. *Red arrows* denote the bile duct orifice. *TXI*, TeXture and color enhancement Imaging; *WLI*, white-light imaging.

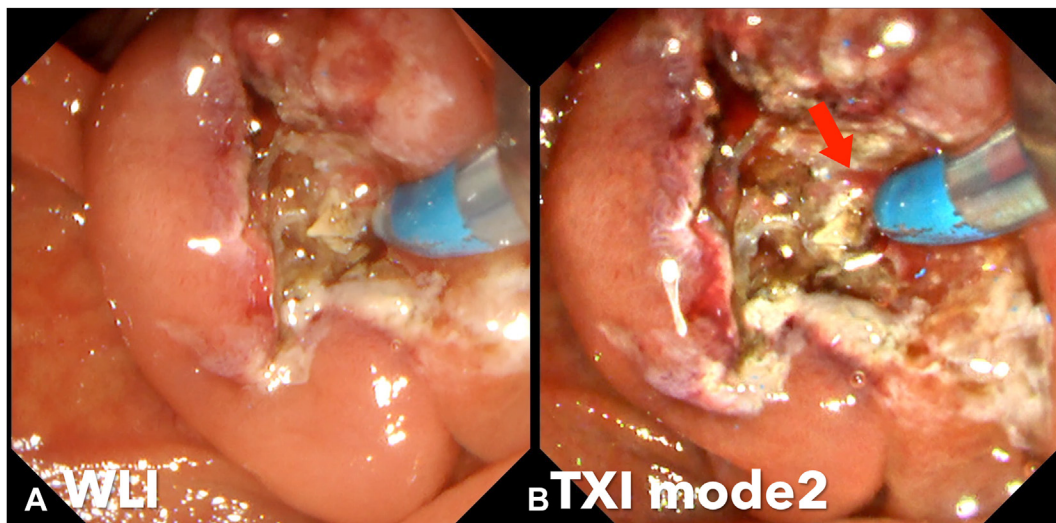


Figure 4. **A**, An ERCP catheter is cannulated through a reddish area on the incision surface, which is identified as the pancreatic duct orifice. **B**, WLI is switched to TXI mode 2 to enhance texture and brightness. Another red area, indicative of the biliary duct orifice, became clearly visible to the left of the catheter (*arrow*). *TXI*, TeXture and color enhancement Imaging; *WLI*, white-light imaging.

the best of our knowledge, there is no video report that provides a detailed description of how the actual precut incision surface appears in TXI. Here, we present the videos of 3 patients in whom biliary cannulation was successfully achieved by detailed observation of the incision surface during TXI-assisted precutting.

CASE PRESENTATION

Case 1 was an 84-year-old man. During the first ERCP session, biliary cannulation failed; therefore, we inserted only a pancreatic stent. A few days later, a second ERCP was performed. Needle knife precut sphincterotomy was performed using WLI, and a red ring-shaped structure was observed.

The structure was clarified by changing from WLI to TXI mode 1, which enhanced the texture, brightness, and color. The irregularities in the incision surface were clear. The view was slightly milder with TXI mode 2, which enhances texture and brightness. Biliary cannulation was achieved using TXI. TXI aided in differentiating the anatomical structures, allowing for more precise identification of the bile duct orifice during the precut procedure. In this case, we can compare WLI, TXI mode 1, and TXI mode 2 during precutting. Although WLI can be used to identify the bile duct orifice, TXI offers better visibility of both the bile duct orifice and the layered structure of the incision surface. Mode 1 provides more pronounced emphasis, which may cause eye fatigue with prolonged use. In contrast, mode 2 enhances texture and brightness without altering color, resulting in a

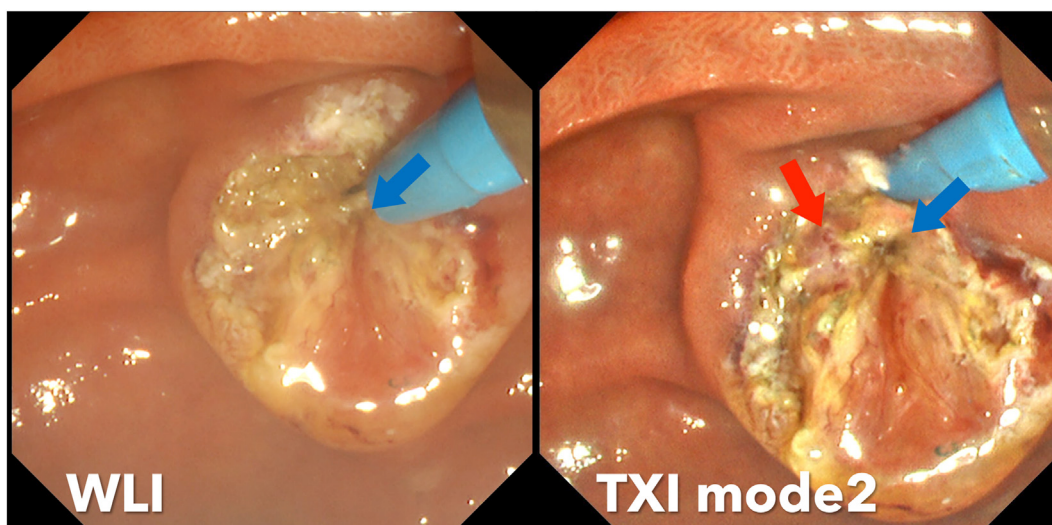


Figure 5. Smoke is generated during precutting, resulting in poor visibility. The effect seems to be reduced after changing to TXI. TXI mode 2 revealed irregularities on the incision surface. We found a bile duct orifice, a white bundle-like structure, and a slit-like red area (*red arrow*) adjacent to the left side of the pancreatic duct orifice (*blue arrow*). TXI, TeXture and color enhancement Imaging.

milder emphasis (Fig. 3). No conclusion has yet been reached as to whether mode 1 or mode 2 is more suitable for precutting.

Case 2 was an 81-year-old woman. Biliary cannulation was challenging because of a large oral protrusion. Precutting was performed using a needle knife with WLI. We observed a reddish area on the incision surface. The ERCP catheter was cannulated through the area, which was a pancreatic duct orifice. When TXI mode 2 was used with the catheter cannulated into the pancreatic duct, another red area was observed just left of the catheter (arrow), which was a biliary duct orifice, and enabling biliary cannulation (Fig. 4).

Case 3 was a 76-year-old woman. We performed trans-pancreatic sphincterotomy with WLI; however, because of the insufficient incision length, needle-knife precutting was also used. Although a satisfactory incision was created, the bile duct orifice was not identified with WLI. When transitioning from WLI to TXI mode 2, which revealed irregularities on the incision surface, we observed a white bundle-like structure and a slit-like red area adjacent to the left side of the pancreatic duct orifice, which facilitated successful biliary cannulation (Fig. 5).

CONCLUSION

Despite the roughness of the precut incision surface, TXI improves visibility and aids in biliary cannulation.

PATIENT CONSENT

This study was approved by the Ethics Committee of the Japanese Red Cross Asahikawa Hospital. Informed consent

was obtained from the patient to publish this case report and accompanying images.

DISCLOSURES

All authors disclosed no financial relationships.

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