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Use of TXI™ Technology (Texture and Color Enhancement Imaging) to Enhance Visibility And Optimize Adenoma Detection Rate

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Introduction

Colonoscopy continues to be the gold standard for colorectal cancer (CRC) screening and prevention.¹⁻³ The ability to optimize visualization of the mucosa during colonoscopy is critical in detecting and removing lesions.^{3,4} Suboptimal visualization may result in missed lesions and, consequently, opportunities for timely treatment and a reduced risk for cancer.⁵ An estimated 26% of adenomas are missed during colonoscopy procedures.⁶ Lesion detection may be limited by a number of factors, including bowel preparation, withdrawal time, and nonuniform illumination resulting from the topography of the lumen, all of which may limit identification and characterization of lesions.^{1,4,7}

Right-sided polyps and flat lesions can be particularly challenging to detect and often have higher missed rates.^{1,4,8} “The classic areas for missed polyps and difficult detection are the right colon, especially around the hepatic flexure, the cecum below the IC [ileocecal] valve, and the sigmoid colon,” said Gregory Haber, MD, the chief of endoscopy at NYU Langone Health and a professor of medicine at NYU Grossman School of Medicine, in New York, New York.

As a key metric of colonoscopy screening, the adenoma detection rate (ADR)—the proportion of screening colonoscopies that detect colorectal adenomas—measures the quality of mucosal

inspection.^{4,5} The ADR also is strongly associated with the risk for interval cancer: A 1% increase in ADR results in a 5% decrease in the risk for fatal interval CRC.⁵ Patients whose endoscopists have an ADR of less than 20% have a higher risk of developing interval cancer⁴; thus, taking steps to increase ADR is essential to cancer prevention. “There’s been a tremendous focus over the last decade on polyp detection to reduce the interval colon cancer rate,” Dr Haber said. “The heightened awareness in the endoscopy community and quality metrics which focus on polyp detection have been an impetus to development of technological advances to raise the ADR and mean APC [mean adenomas per colonoscopy].”

With the recent introduction of the Olympus® EVIS X1™ endoscopy system, clinicians are equipped with a number of advances engineered to revolutionize the detection, characterization, and treatment of gastrointestinal lesions. As part of the portfolio of available tools with the EVIS X1 endoscopy system, Texture and Color Enhancement Imaging (TXI™ technology) is designed to increase the visibility of potentially suspicious lesions and polyps by enhancing image color, structure, and brightness.^{7,9} When used during endoscopic screening, TXI technology can help the endoscopist visualize features of the mucosa that may not be as clear with white light alone.⁷ “Almost all of the new technologies in colonoscopy have focused on improved polyp detection and removal,” Dr Haber said. “TXI technology is a technology that is designed to enhance the surface features of the mucosa of the GI tract—features which will allow us to distinguish normal from abnormal tissue.”

TXI Technology Capabilities

During a procedure, the endoscopist can switch on the TXI technology to instantly enhance visibility (Figure 1). When it is activated, the color, texture, and brightness of the mucosal surface image are optimized by splitting the image into several layers, enhancing the texture and brightness across the layers, and then merging the split images back together.⁹

TXI™ technology combines 3 image processing algorithms to enhance visibility of the mucosa: brightness correction of the dark part of the image; color difference expansion processing; and texture component emphasis processing.⁹ The features of using TXI technology include⁹:

- **Color contrast enhancement:** Subtle changes in color on the mucosa are easily visible. This can be particularly useful for applications such as detecting sessile lesions, which are often pale or similar in color to the surrounding mucosa.
- **Brightness:** A brighter image improves the visibility of surface features and increases the viewable distance.
- **Texture enhancement:** Changes to surface patterns are more visible; abnormal surface patterns such as sessile or other flat lesions, which are notoriously difficult to detect, are more visible.

The end result is a real-time image that delineates fine details on the mucosal surface including polyps, lesions, inflammation, and subtle mucosal changes.² Because the image is captured using white light and TXI technology is applied during post-processing, the color profile of the final image remains similar to that of white light, making it more relatable and familiar.⁹

Together, these features are designed to function as a

simple-to-use tool that enhances the endoscopist's ability to detect critical mucosal features in support of cancer prevention and disease management. "There are 2 modes of TXI technology with or without the color enhancement applied; one can use both depending on how much color enhancement is desired. In effect, the brightness, the resolution of the surface, and the color enhancement all work together in isolating abnormal topographic features," Dr Haber said. "I think it's the combination that works so well together. By virtue of these features, TXI technology is reengineering white light for endoscopy."

Practical Considerations for TXI Technology

According to Dr Haber, TXI technology is a useful tool to boost the endoscopist's ability to carefully evaluate the mucosal surface and can be beneficial not only in CRC screening but also in clinical scenarios that rely on good visualization, such as delineating the margins of lesions, viewing fibers while working in the submucosal space, scoring disease activity in inflammatory bowel diseases, and assessing Barrett's esophagus. "A lot of polypectomies are done now without fluid injection or dyes; rather they're done with cold snaring for smaller and flatter lesions. Being able to clearly see the margins becomes an

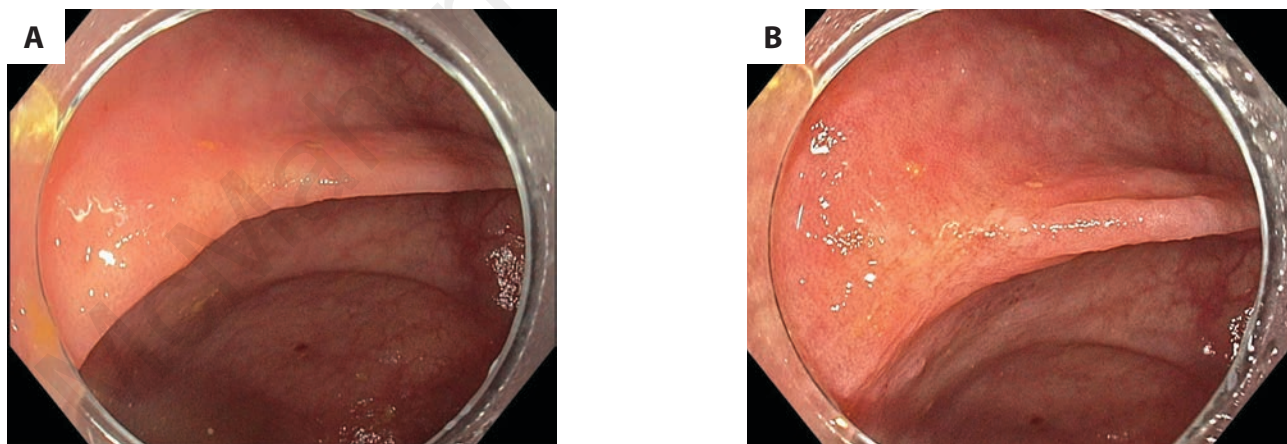


Figure 1. Scar after EMR of a polyp that showed adenocarcinoma:

Image in (A) white light and (B) image in TXI technology mode.

In the case illustrated here, it was critical to identify the scar post-EMR, as the diagnosis of cancer in the resected polyp was completely unexpected. Once the scar was delineated, with the help of TXI technology, a full-thickness resection could be carried out to ensure there was no residual cancer, thus preventing a colon resection.

EMR, endoscopic mucosal resection; **TXI technology**, Texture and Color Enhancement Imaging.

important factor in the quality of your polypectomy,” Dr Haber said. “One thing is seeing it; another thing is ensuring that you remove it entirely. The TXI™ technology enhancement of the surface gives me a better look at margins, especially subtle and irregular margins where the topographic features aren’t as distinguishable. That allows for a good margin of normal tissue to ensure that there is no residual neoplastic tissue, either overt or occult.”

Clinical Data

The use of TXI technology on polyp detection during colonoscopy was evaluated in a recent multicenter, randomized controlled trial of 4 physicians with at least 5 years of prior colonoscopy experience using the EVIS X1™ endoscopy system and high-definition EVIS EXERA™ III CF-HQ190 colonoscopes.¹⁰ Consecutive patients were randomly assigned to either white light endoscopy (WLE) or TXI technology mode 1—includes color contrast enhancement.¹⁰ Each physician selected their randomly assigned mucosal imaging after colonoscope insertion to the cecum.¹⁰

A total of 338 adult (age ≥18 years) patients were recruited for the study with 14 patients being excluded after randomization due to inadequate bowel preparation (n=10) or an incomplete procedure (n=4).¹⁰ Although the study enrolled participants with diverse indications for colonoscopy, such as a positive fecal occult blood

test, undergoing surveillance colonoscopy, or presenting with symptoms, the TXI technology and WLE groups had similar baseline characteristics.¹⁰

The primary outcome of the study was ADR for proceduralists using TXI technology versus WLE.¹⁰ The results showed that ADR was 54.6% for endoscopies using TXI technology, which was significantly higher than that of endoscopies using WLE (40.99%; $P=0.01$) (Figure 2).¹⁰ In addition, TXI technology supported an increase in ADR for physicians with an ADR greater than 55% (high detectors) and less than 55% (standard detectors).¹⁰ The mean APC for high detectors in the TXI technology group was 2.82 compared with 1.13 in the WLE group ($P=0.006$).¹⁰ In standard detectors, the mean APC for the TXI technology group was 1.47 compared with 0.88 for the WLE group ($P=0.03$).¹⁰

“Once you’ve had experience with TXI technology, it’s almost self-evident that this would be the result of the study because it enhances your ability to distinguish abnormal tissue,” Dr Haber said. “What’s interesting with these new technologies is the sudden change in the image. You’re looking at an image of the lining of the bowel and then you flip a switch, and suddenly [the image detail] pops.”

Median withdrawal time was longer in the WLE group than in the TXI technology group (6 minutes, 55 seconds vs 7 minutes,

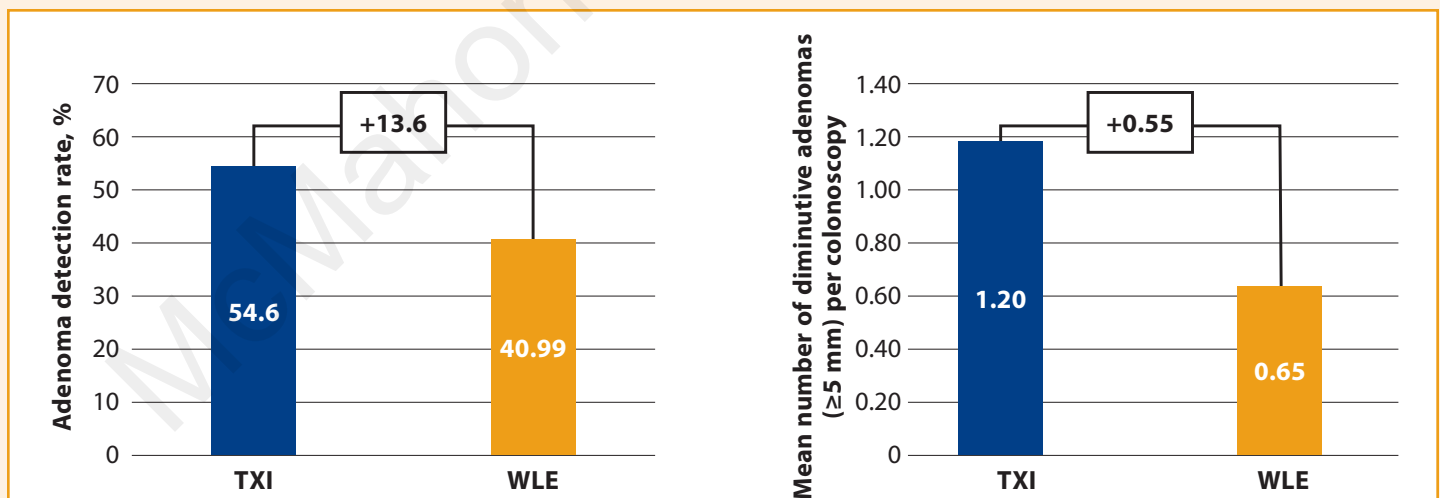


Figure 2. TXI technology improves ADR and adenoma per colonoscopy rate compared with white light.

ADR, adenoma detection rate; TXI technology, Texture and Color Enhancement Imaging; WLE, white light endoscopy.

Based on reference 10.

13 seconds; $P=0.049$), but the mean APC was significantly higher with TXI™ technology compared with WLE (1.71 vs 0.94, respectively; $P<0.01$).¹⁰ TXI technology showed benefit in smaller lesions, which can be difficult to see but are critical to remove in preventing the spread of malignancy.¹¹ For adenomas 5 mm or greater, the mean APC was also higher with TXI technology than with WLE (1.2 vs 0.65, respectively; $P=0.02$) (Figure 2).¹⁰ The mean APC was not significantly different between groups for adenomas 10 mm or greater (0.26 vs 0.15, respectively; $P=0.2$).¹⁰

Results showed that TXI technology detected a significantly higher mean APC for right-sided polyps compared with WLE (1.13 vs 0.73; $P=0.03$).¹⁰ For the detection of flat adenomas, proceduralists using TXI technology detected on average 0.58 flat adenomas per colonoscopy, compared with 0.24 for WLE ($P<0.01$).¹⁰ Dr Haber's experience supports these observations and the implications of using TXI technology to reduce missed rates and increase ADR. "It's a dual challenge: to bring the tissue into the field of view which is a function of scope maneuverability and to carefully interrogate and inspect the surface topography. This is where TXI technology

is very helpful," he said. "I tend to inspect those areas twice, both in forward viewing and in retroflexion, and turning on TXI technology for inspection of these areas is very helpful. Prominent folds, scope abrasion, mucosal edema, and recessed areas can be carefully inspected to rule out a neoplastic process is an abrasion from the colonoscope, a little bit of edema, or an actual neoplastic lesion."

Conclusion

TXI technology improves visibility of the colonic mucosa, optimizing the detection of neoplastic lesions compared with white light, and endoscopists can quickly leverage its benefits to enhance the quality of colonoscopy. Clinical data support the use of TXI technology in endoscopic screening so even small lesions can be detected further increasing ADR and potentially reducing the risk for cancer. "The nice thing about these optical features [of TXI technology]—the resolution, color, and texture enhancement—is that it all can be done with a simple push of a button, like flipping on a light switch," Dr Haber said.

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Disclosure: Dr Haber reported that he is a consultant to Adenocyte, Boston Scientific, Fuji, Microtech, and Olympus.

Disclaimer: TXI™ Technology is not intended to replace histopathological sampling as a means of diagnosis.

The EVIS X1™ endoscopy system is not designed for cardiac applications. Other combinations of equipment may cause ventricular fibrillation or seriously affect the cardiac function of the patient. Improper use of endoscopes may result in patient injury, infection, bleeding, and/or perforation. Complete indications, contraindications, warnings, and cautions are available in the Instructions for Use (IFU).

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