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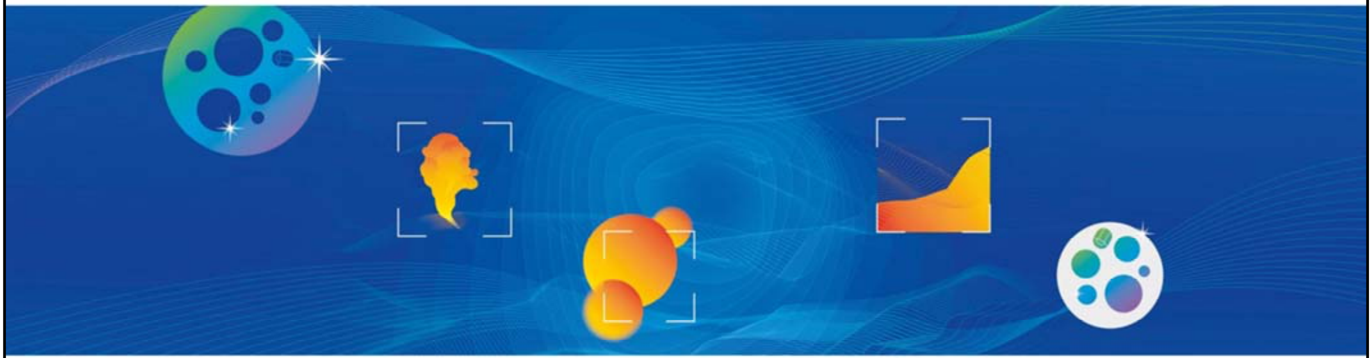
EVIS X1



Technical Description of EVIS X1

Let's be Clear: Elevating the Standard of Endoscopy

Yasuhito Kura, ESD Product Development, Olympus Corporation, July 1, 2020

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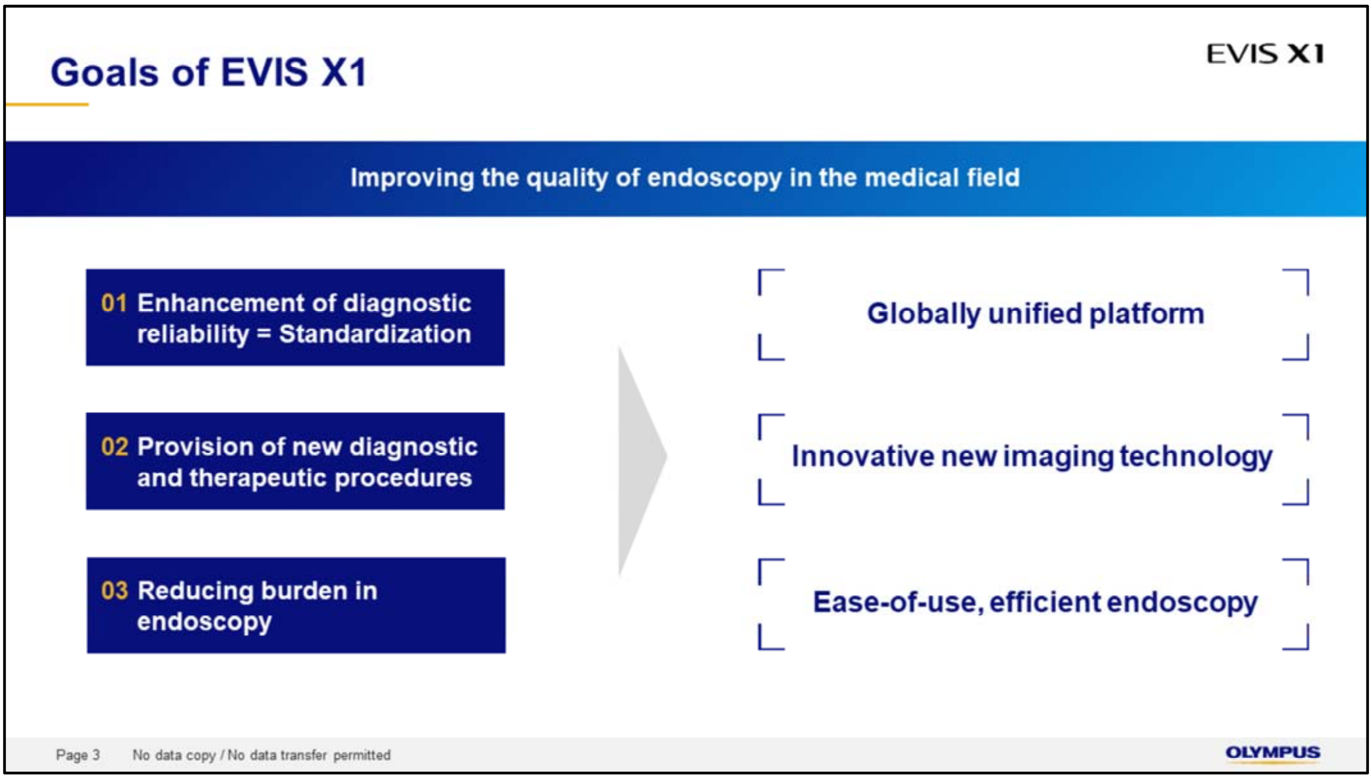

- We have developed EVIS X1 which contributes to improving the quality of endoscopy.
- We received many requests from our customers for the EVIS EXERA and the EVIS LUCERA.
- To meet these demands, our development department set three goals and developed technologies to achieve them.
- The first goal is the development of “globally unified platform” to improve diagnostic reliability and achieve standardization.
- Since the NBI technology was put into practical use, diagnostic criteria and guidelines have been developed on a global level. Standardization on a global scale can be achieved by unifying the standards across all countries and regions. However, at present, endoscopy system differs from region to region, and this has been one of the obstacles to standardization.
- The second goal is the development of “innovative new imaging technologies” to provide new diagnoses and treatments.
- More accurate diagnoses and treatments are always being sought. We recognize that we are expected to provide equipment to realize this.
- The third goal is the development of “user-friendly” equipment that reduces the burden in endoscopy.
- As the benefits of endoscopic screenings and treatments increase, more effective screenings are required. To achieve this, it is necessary to reduce the burden on endoscopists and healthcare professionals.

New Features of EVIS X1

EVIS X1

Globally unified platform
- 5 LED spectrum technology
- New CMOS image sensor

Innovative new imaging technology
- TXI (Texture and Color Enhancement Imaging)
- RDI (Red Dichromatic Imaging)
- EDOF (Extended Depth of Field)

Ease-of-use, efficient endoscopy
- Ergo Grip
- Touch panel: New user interface, My CV mode

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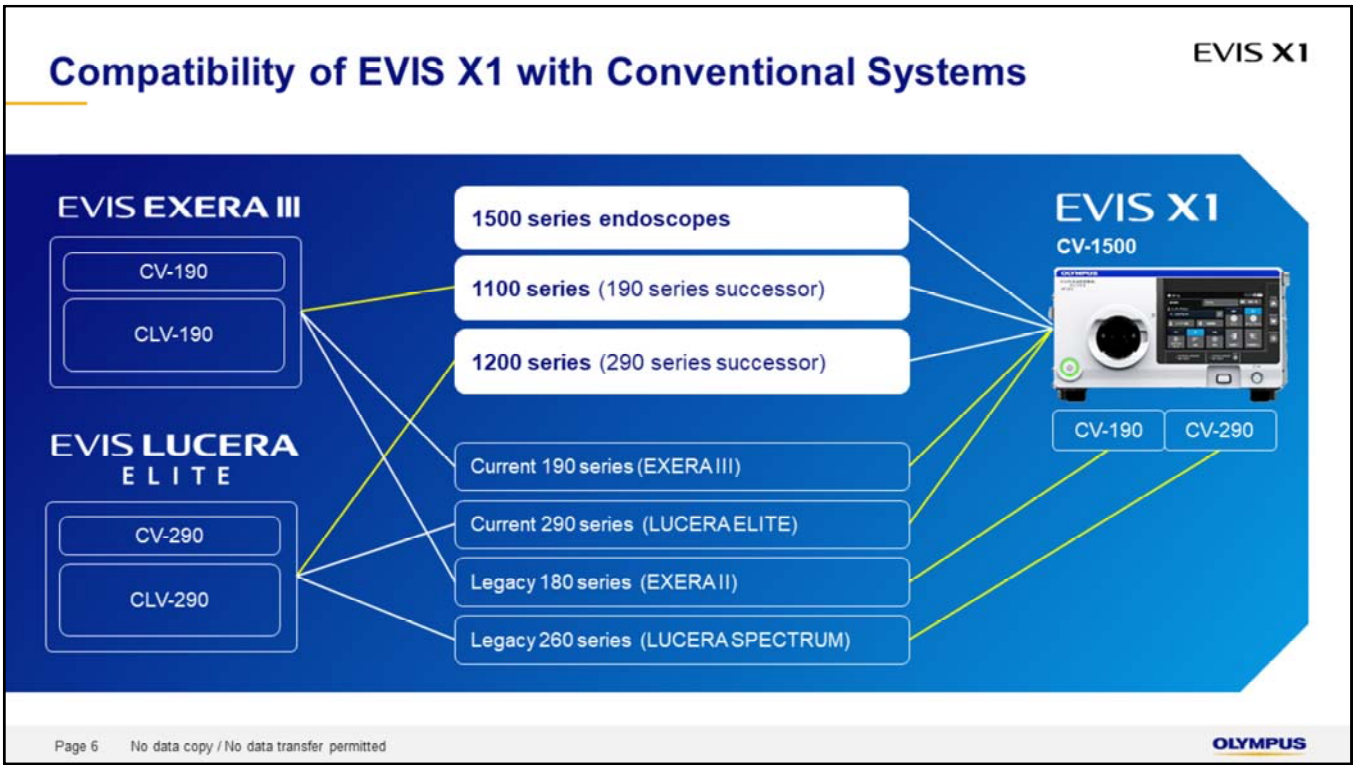
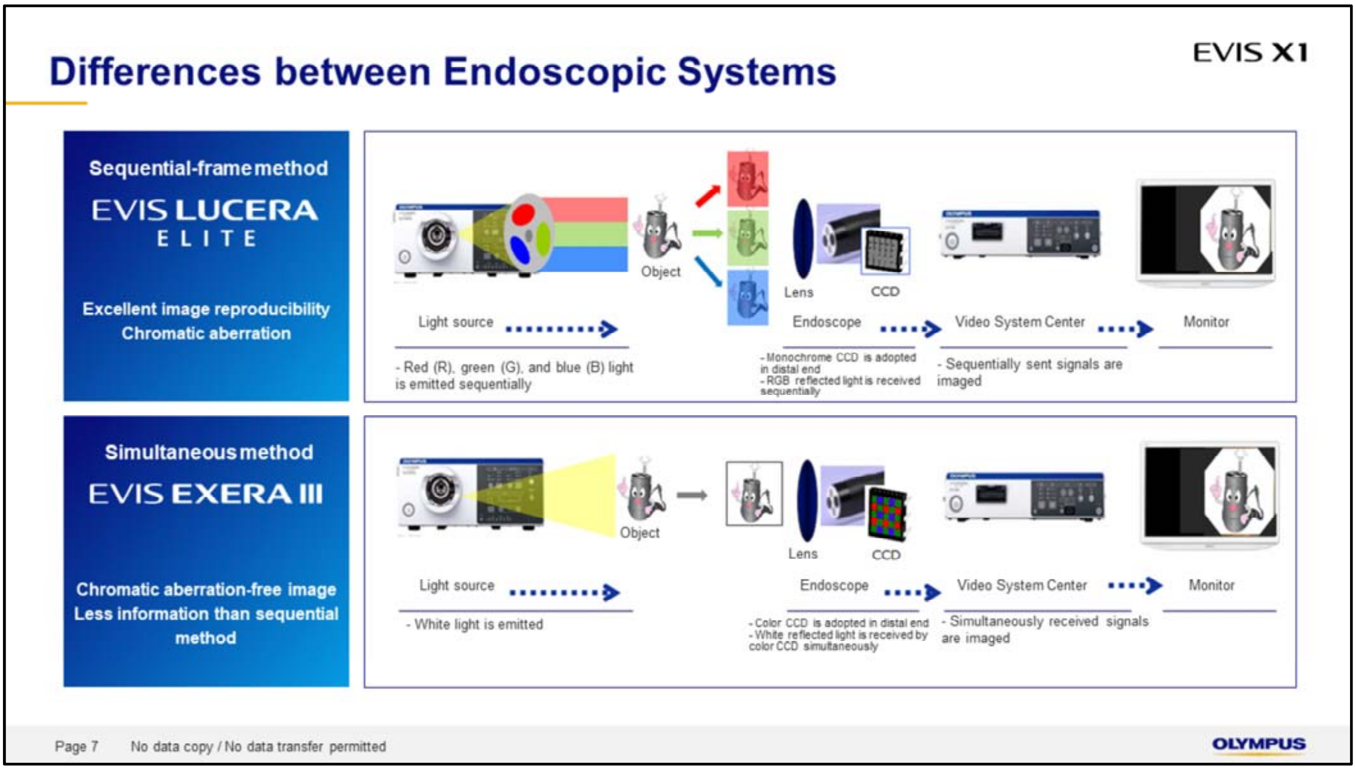
- The EVIS X1 has many new features that help to achieve these three goals.
- Of the new features, today I will introduce seven key functions.

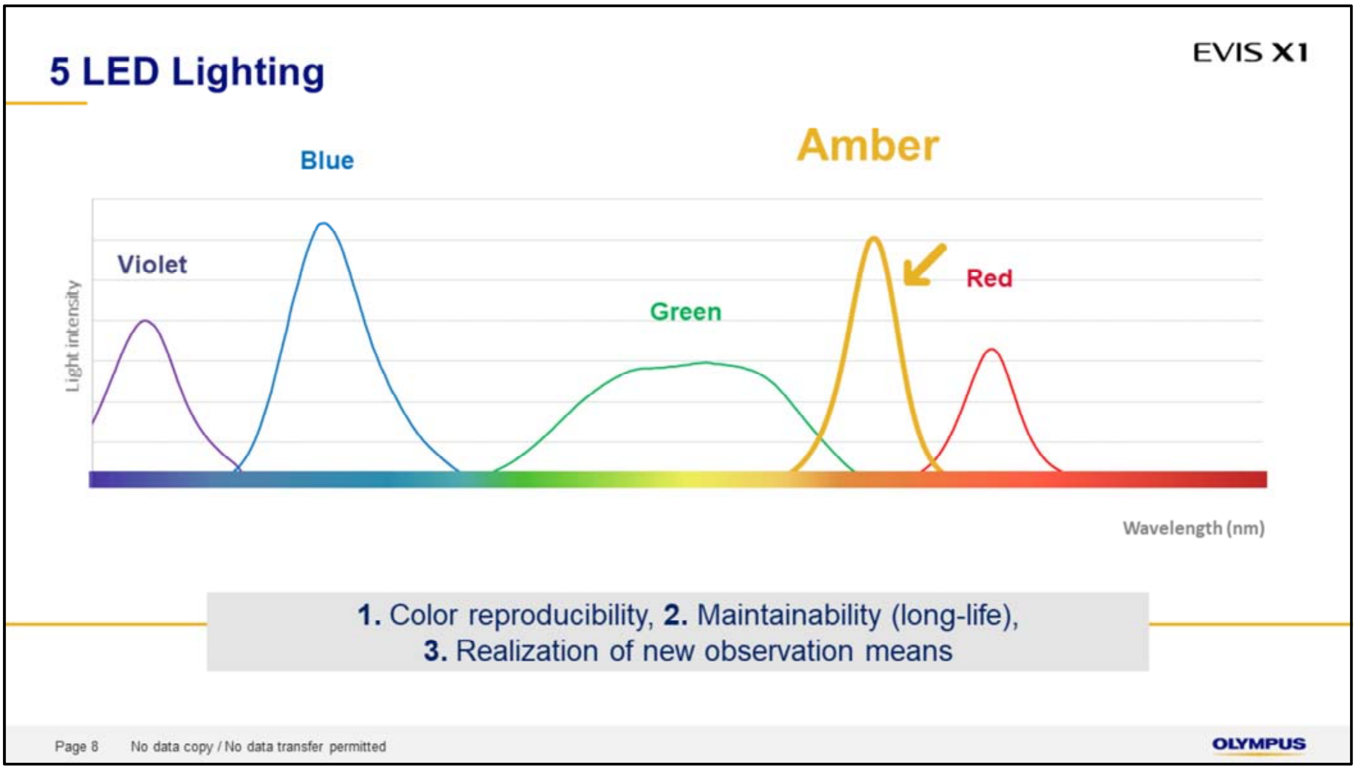
- To unify endoscope systems globally, it was necessary to develop 5 LED spectrum technology and a new image sensor.
- Let me explain these two technologies.



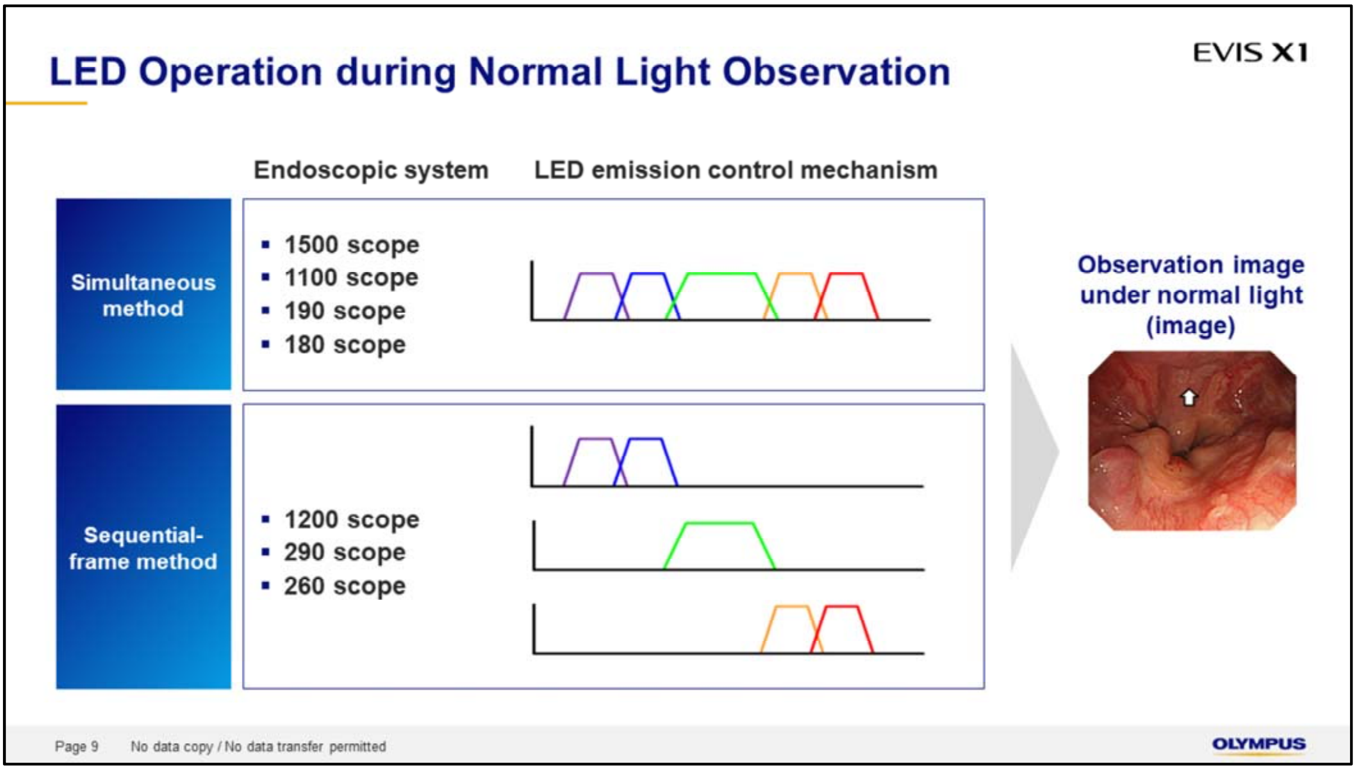
- The EVIS X1 is globally unified platform while maintaining compatibility with conventional models.
- We can also use scopes used in conventional systems with the EVIS X1.
- In addition, we can use all scopes of both EVIS EXERA and EVIS LUCARA series with the EVIS X1.
- Conversely, we can use 1100/1200 scopes developed for the EVIS X1 series with conventional systems. I’ll explain the technical details.



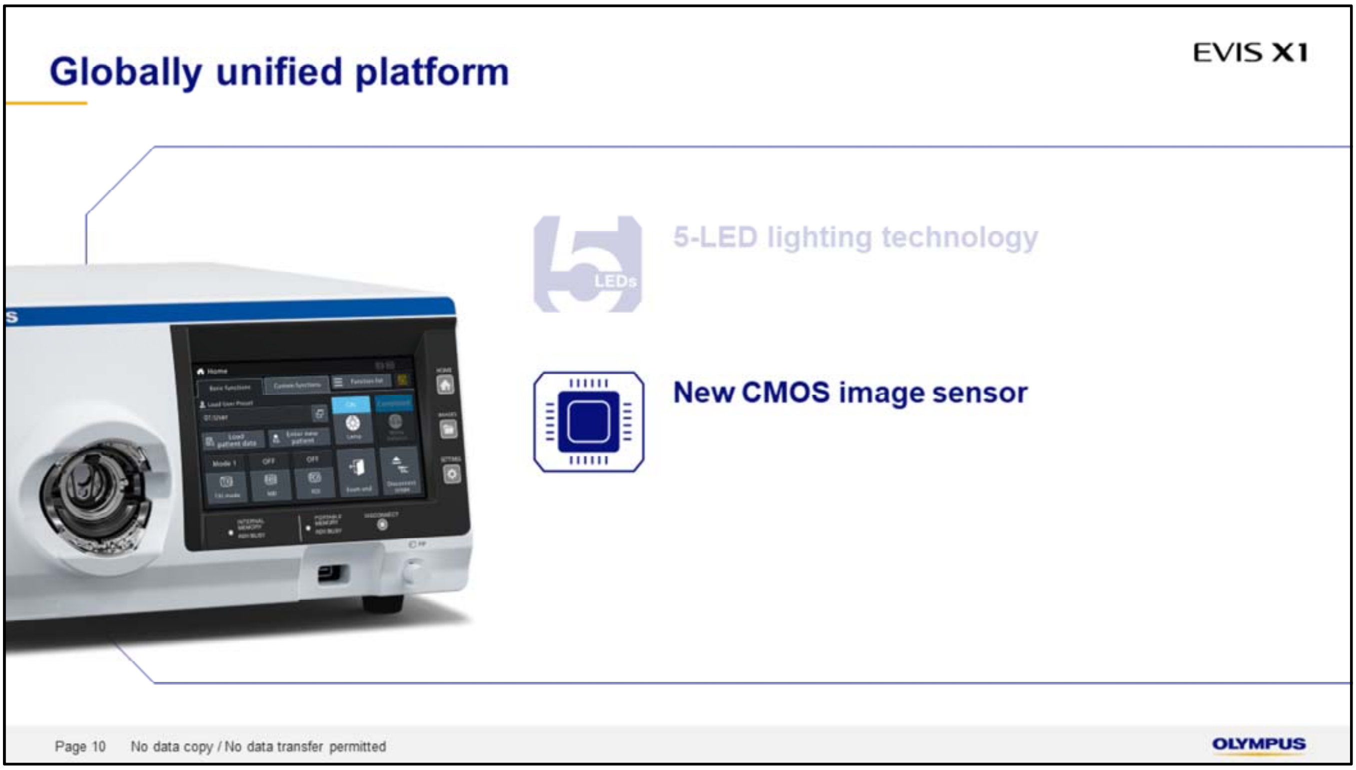
- I would like to briefly explain why we developed two types of EVIS system, the EVIS EXERA system and the EVIS LUCERA system, in the past.
- The LUCERA system adopts the sequential-frame method that emits RGB light as illumination light and receives it as a three-color image with a monochrome CCD.
- Conversely, the EXERA system uses the simultaneous method that emits normal white lamp light and receives it as a single image with a color CCD.
- Technically speaking, there are two major differences in terms of the illumination light and the imaging sensor for capturing images. In terms of performance, there are advantages and disadvantages such as image quality, chromatic aberration, and complexity of signal processing.



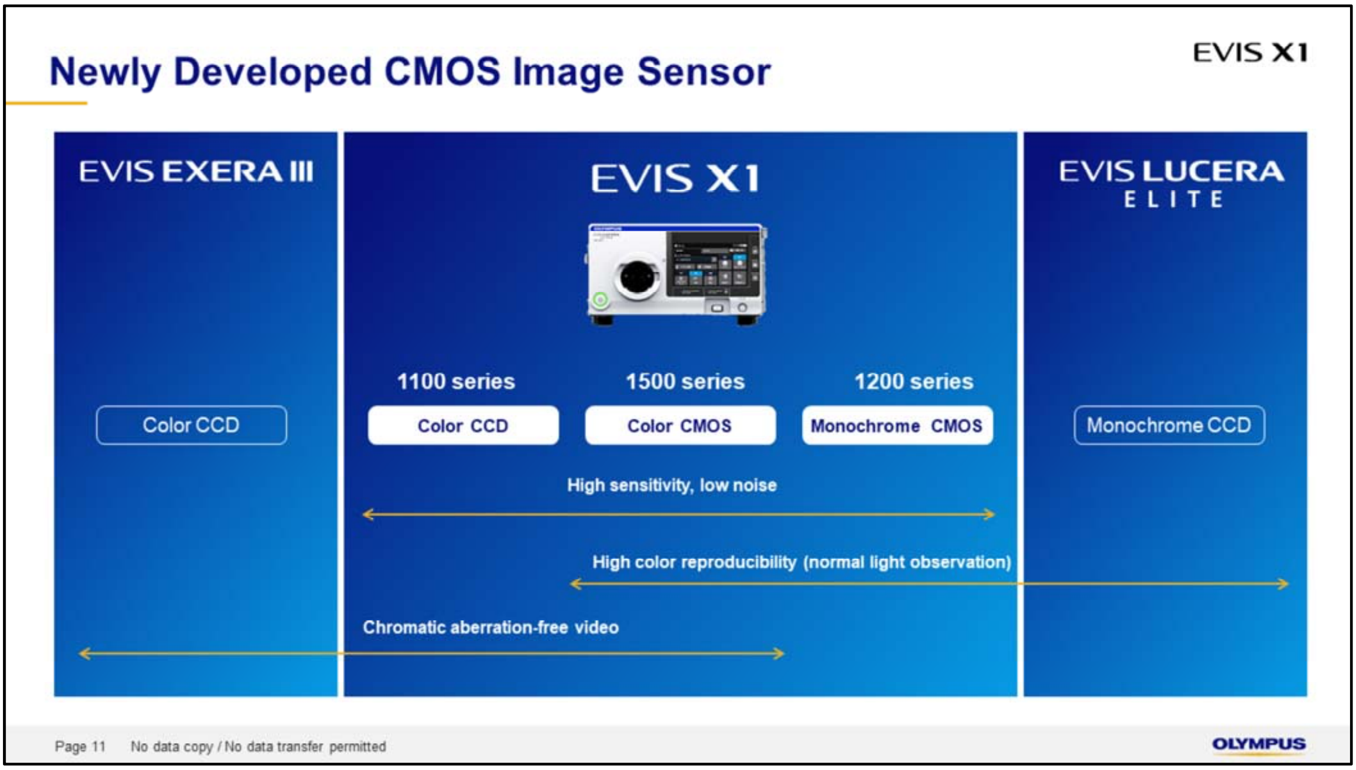
- With the EVIS X1, we replaced the xenon lamp with a light source consisting of five LEDs.
- In addition to the violet, blue, green, and red LEDs that already exist in the world, we newly developed a unique LED, an amber LED.
- These five LEDs, a newly developed CMOS sensor and an image processing algorithm achieve excellent color reproducibility and contrast for the red colors of bleeding and inflammation, etc.
- The newly developed amber LED is an important element to realize the RDI function, which will be explained later.
- In addition, LEDs have a longer service life than the xenon lamp and are easier to maintain and use.



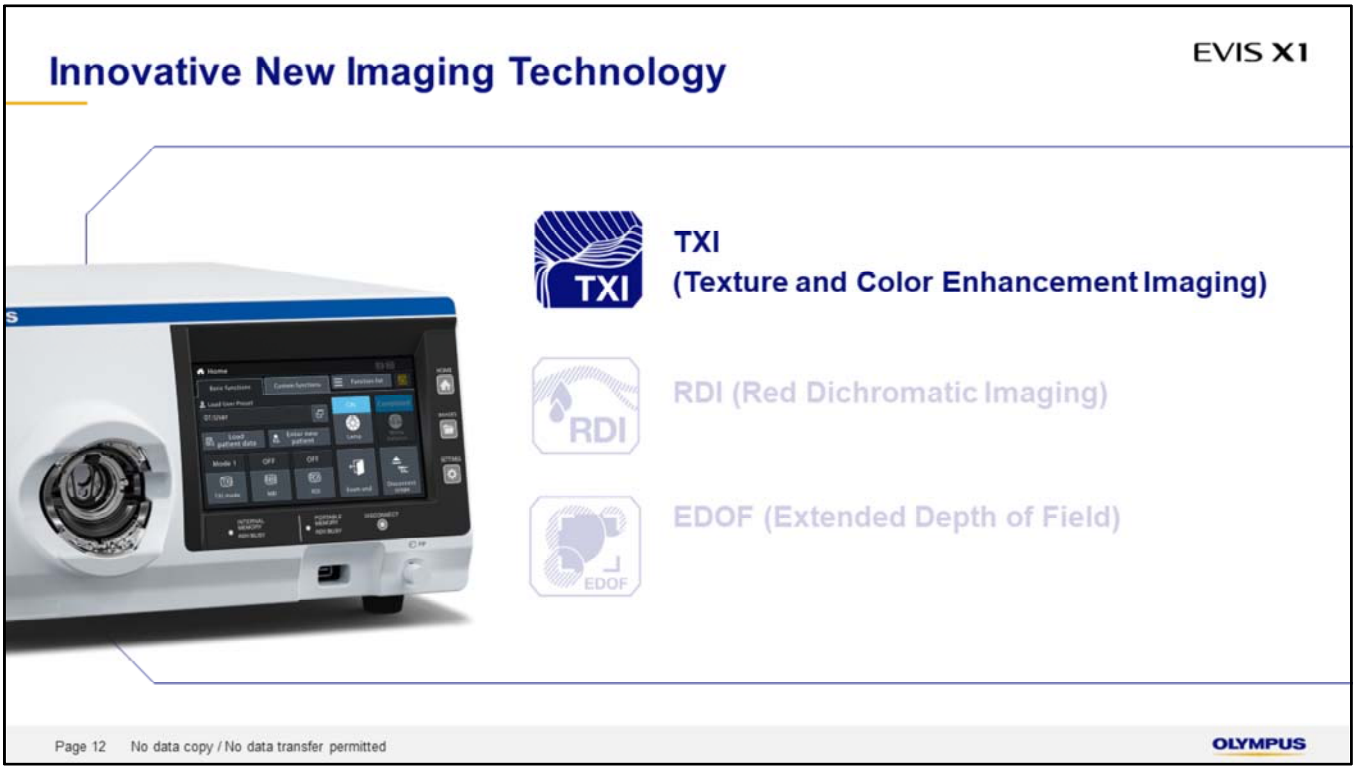
- 5-LED lighting can be used for both simultaneous and sequential-frame method by controlling the emission timing of the LED lights to suit the endoscope to be used.
- The chart in the upper half of the slide shows operation when the system is used as simultaneous method. As shown in the chart, all LEDs emit light in a well-balanced manner, which makes it possible to produce normal light known as white light.
- The chart in the lower half of the slide shows operation when the system is used as sequential-frame method.
- Images can be captured based on the three primary colors by controlling the light emission/dimming of violet and blue, green, amber and red sequentially.



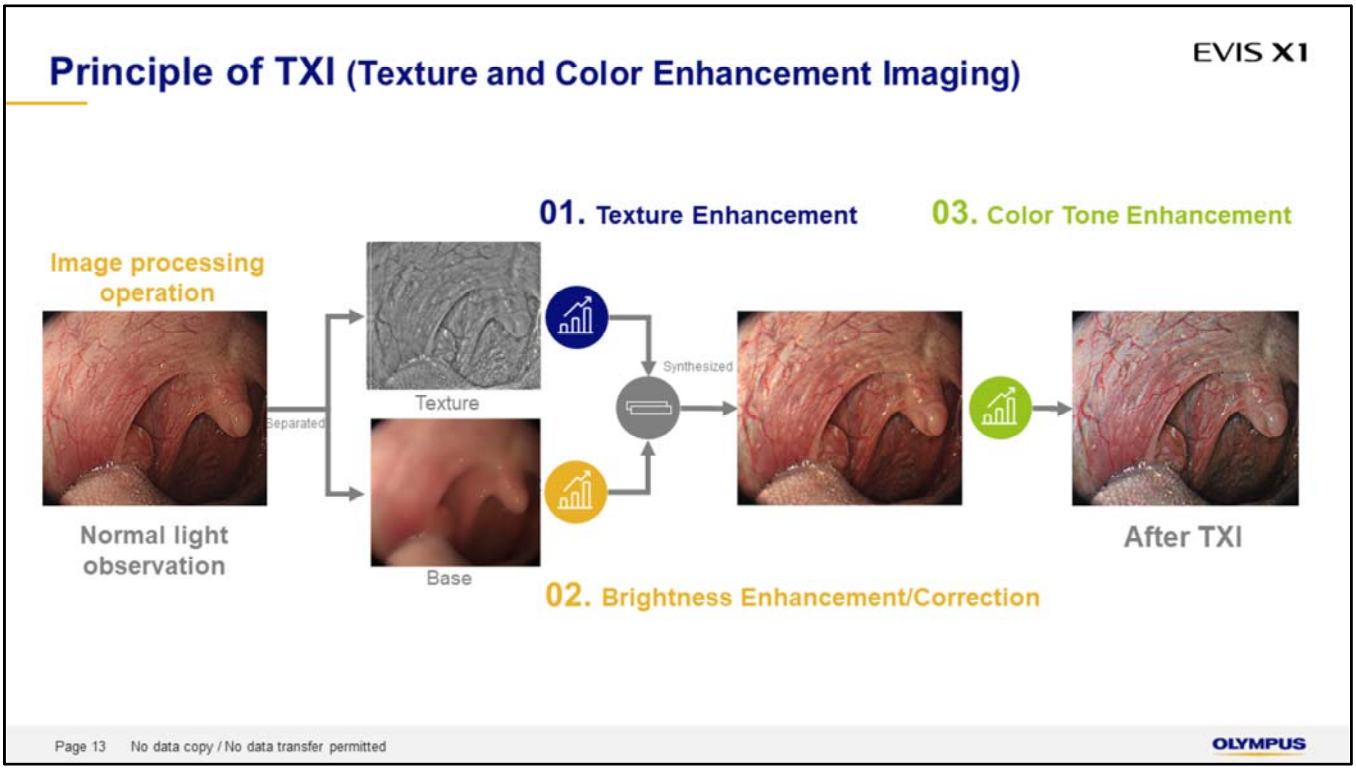
- Next, I would like to move on to the image sensor developed for globally unified platform.



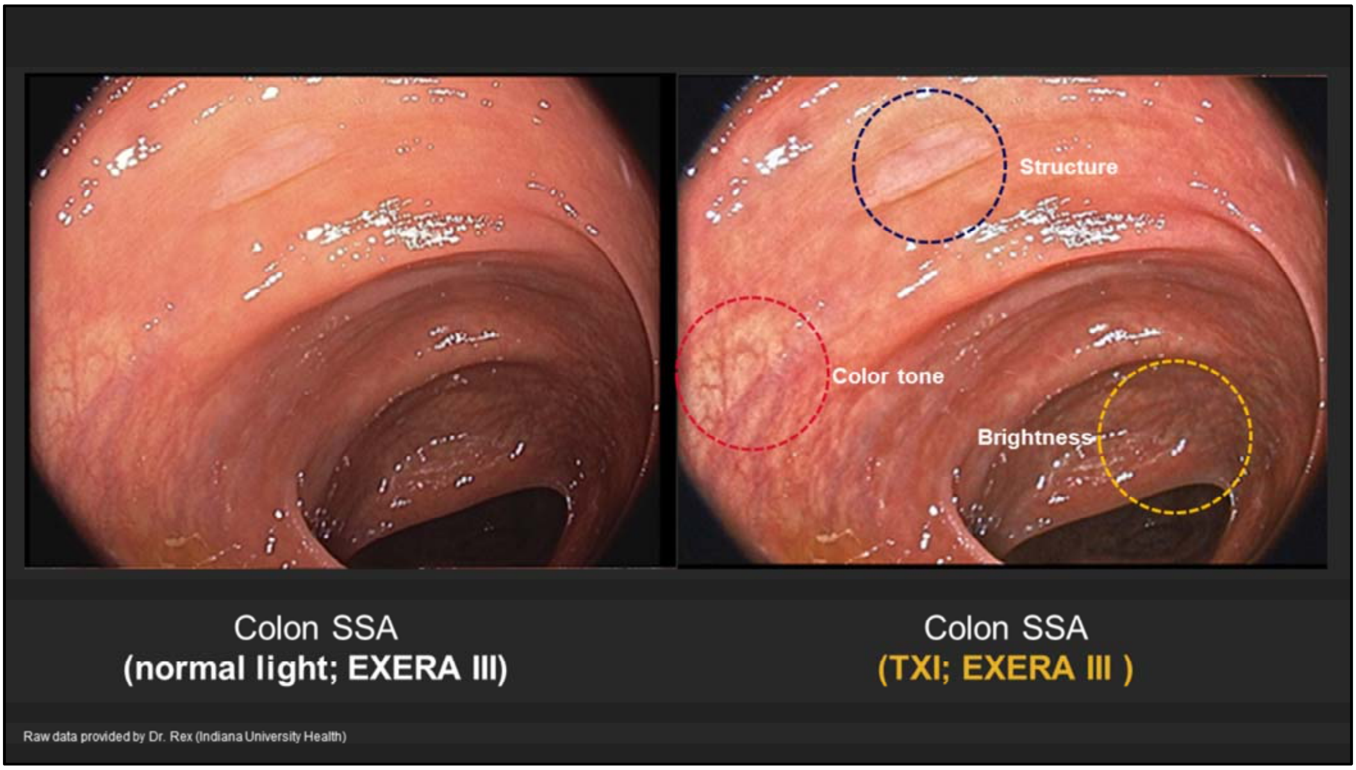
- The color CMOS sensor developed as an image sensor exclusively for the EVIS X1 has basic performance of improved sensitivity and reduced noise.
- It also has the advantages of image sensors adopted for conventional simultaneous and sequential-frame systems: (1) chromatic aberration in rainbow colors is prevented, and (2) color reproducibility is excellent.



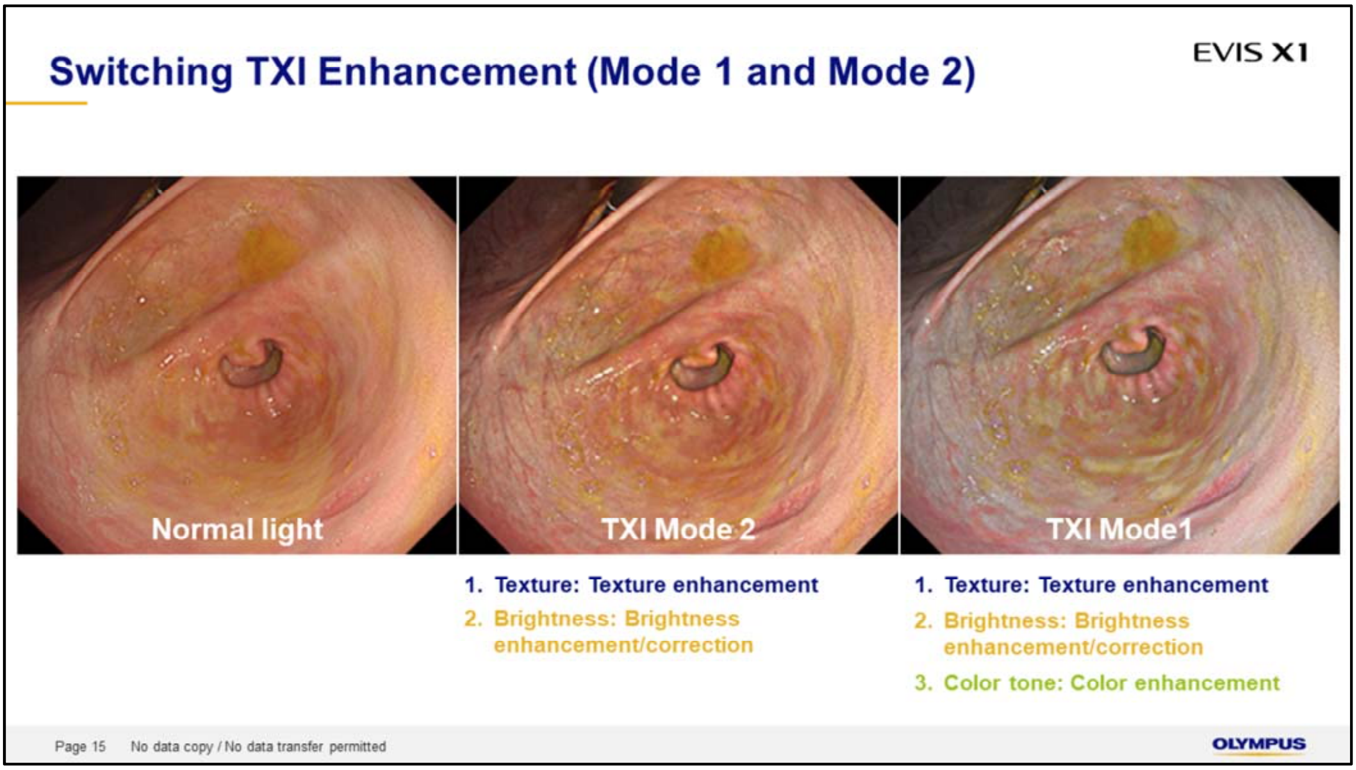
- I will explain the three imaging technologies newly adopted for the EVIS X1, next.
- Let’s look at texture and color enhancement imaging, TXI first.
- TXI is a technology that optimizes texture, color, and brightness of the observation object.
- This function supports endoscopic observation by enhancing the surface roughness and color tone change.



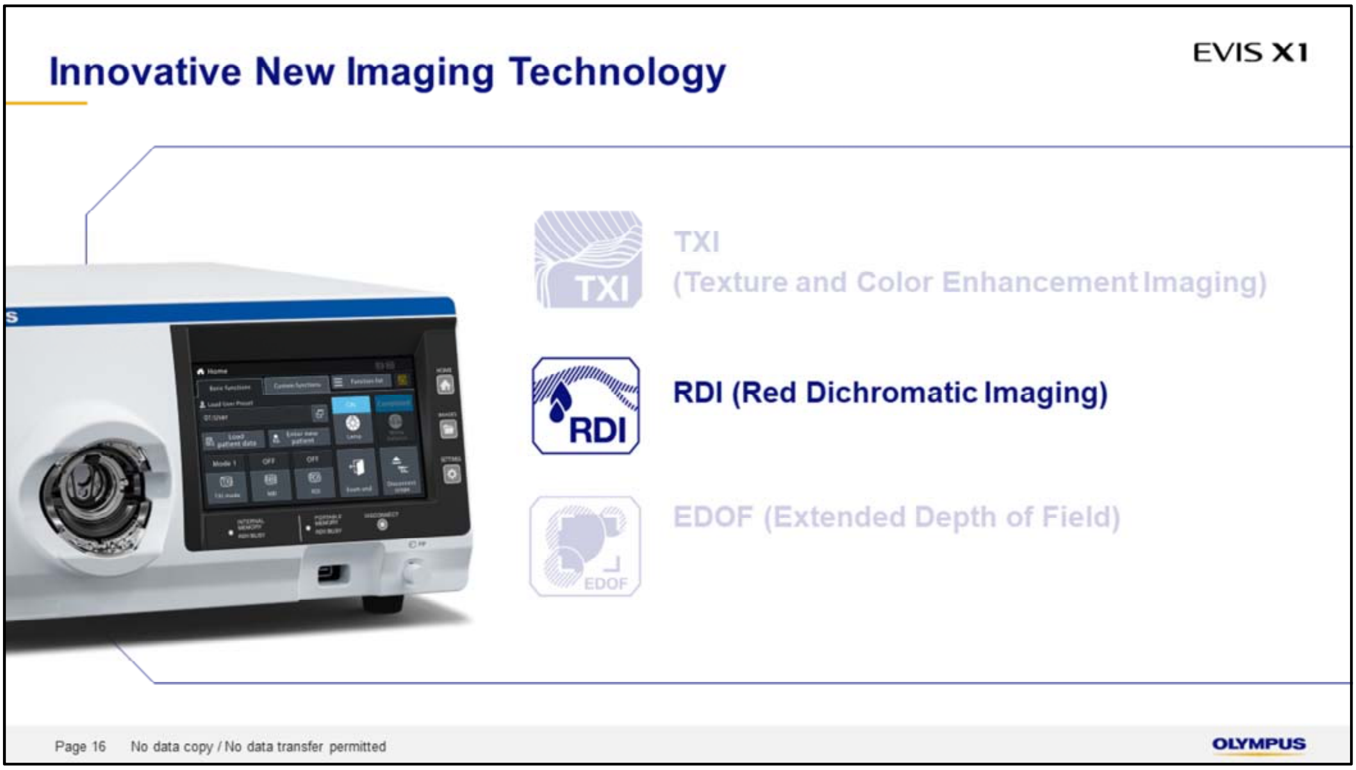
- Here's the principle of TXI.
- The image is processed based on the image captured in normal light observation.
- In step one, the image is divided into the texture image, which is the roughness, and the base image, which is the brightness/color component.
- Then, each image is subjected to an enhancement process.
- The synthesis result of the images is this.
- Unlike the original image, the contrast of the roughness is enhanced and bright and dark areas are corrected, resulting in a corrected image.
- In the final step, an image that enhances color tone and highlights the red areas is created.
- In the EVIS X1 system, this image processing can be executed in real time according to instructions by the operator.



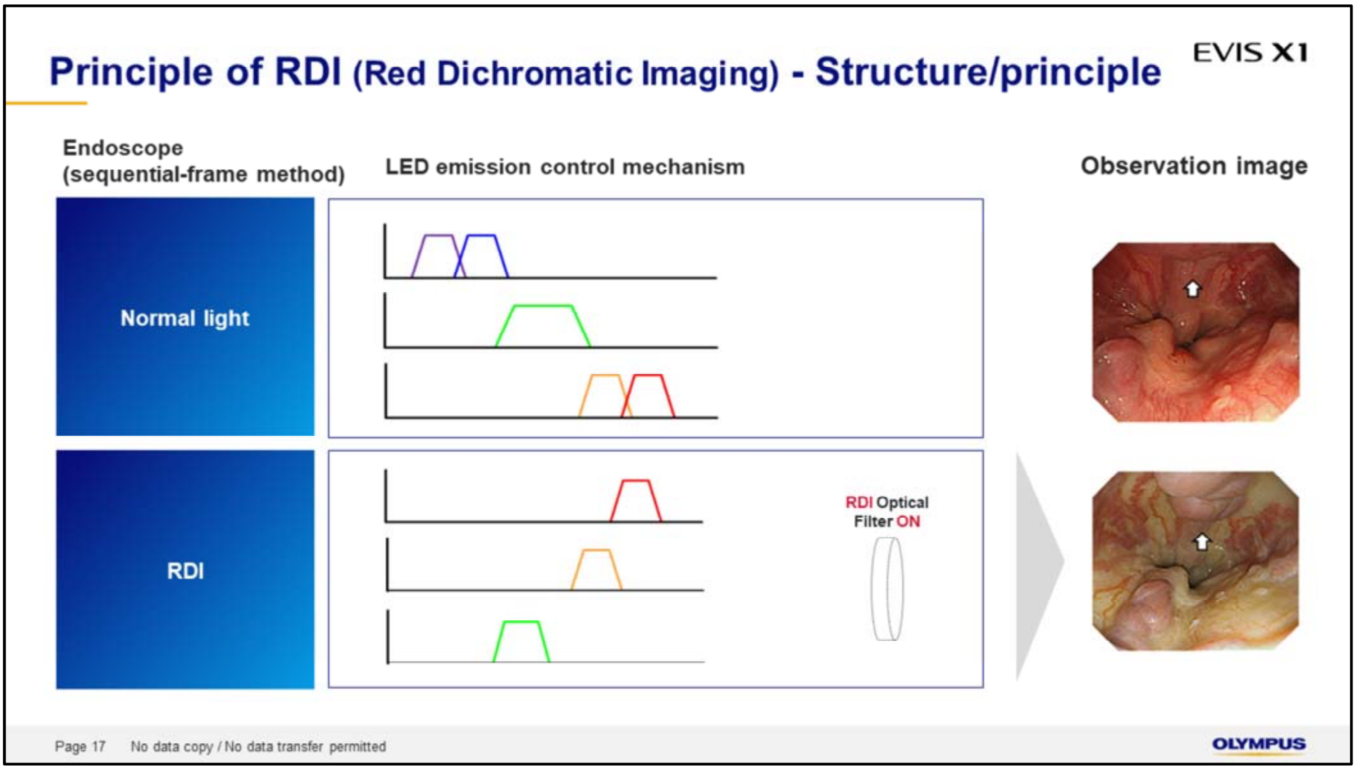
- Let's look at the effects of TXI.
- This image was captured using the current model of the EXERA III endoscope.
- On the left is the normal observation image, and on the right is the image after TXI.
- You can see that the texture, color and brightness are enhanced.
- As shown in the image, it can be used in combination with conventional endoscopes.



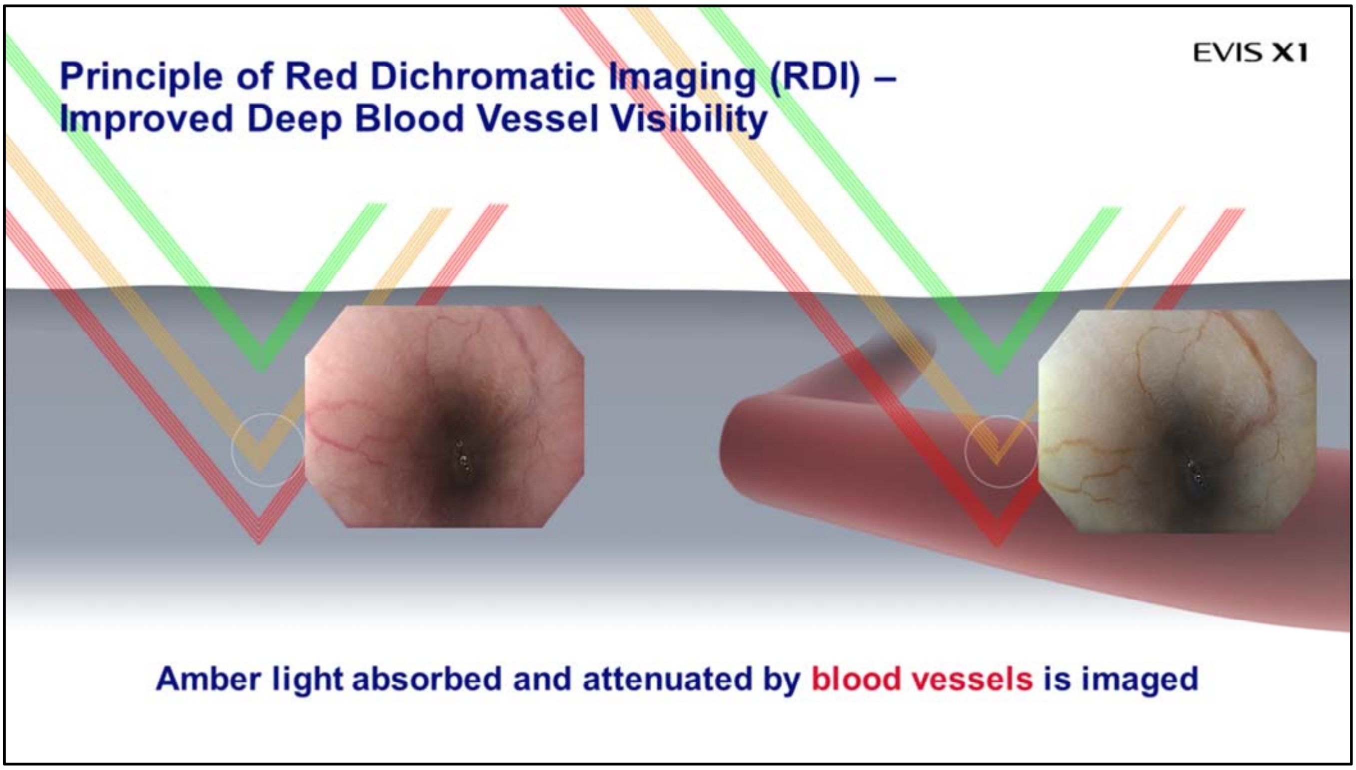
- TXI has two enhancement modes.
- Mode 1 executes all aforementioned three enhancement effects.
- With the color enhancement effect applied, white areas become whiter and red areas with inflammation, etc., become redder, making a strong contrast. However, when compared to normal observation, the color difference is significant, and the change from conventional, familiar images may appear strange.
- In this case, Mode 2, which does not apply any color enhancement, can be selected.
- With this mode, the color tone is close to that of normal observation image, and it supports observation without any strange feeling.



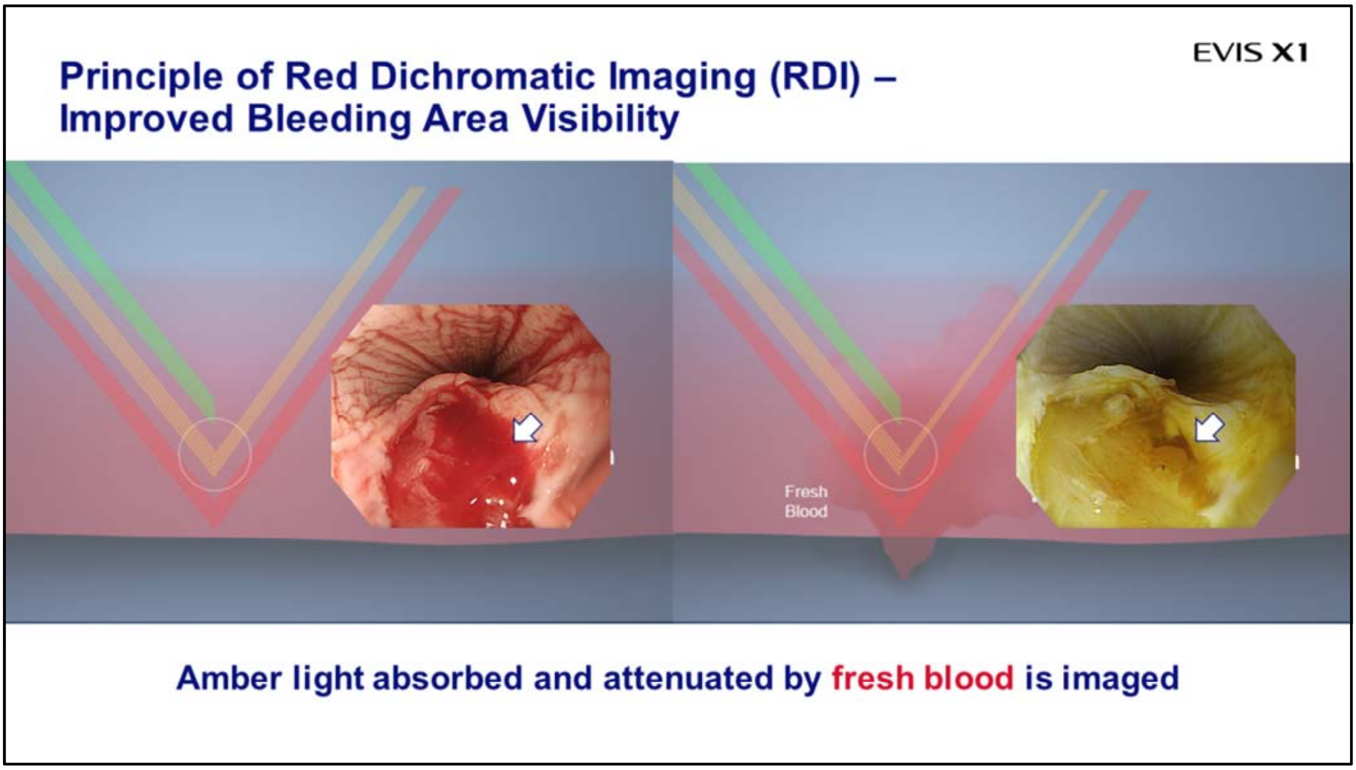
- Let’s move on to RDI.
- RDI (red dichromatic imaging) is a new observation technology uniquely developed by Olympus that uses a narrow band of red, amber, and green wavelengths of illumination light that is different from the illumination light for normal light observation.
- In recent years, the length of hospital stays and the burden on the patient have been reduced in comparison with open surgery thanks to endoscopic therapies such as endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD) .
- Use of RDI is expected to enhance the visibility of deep blood vessels and bleeding areas.
- We believe that we can contribute to safer and more efficient endoscopic treatments by supporting the prevention of bleeding during endoscopic treatment and the quick and easy hemostasis of bleeding.



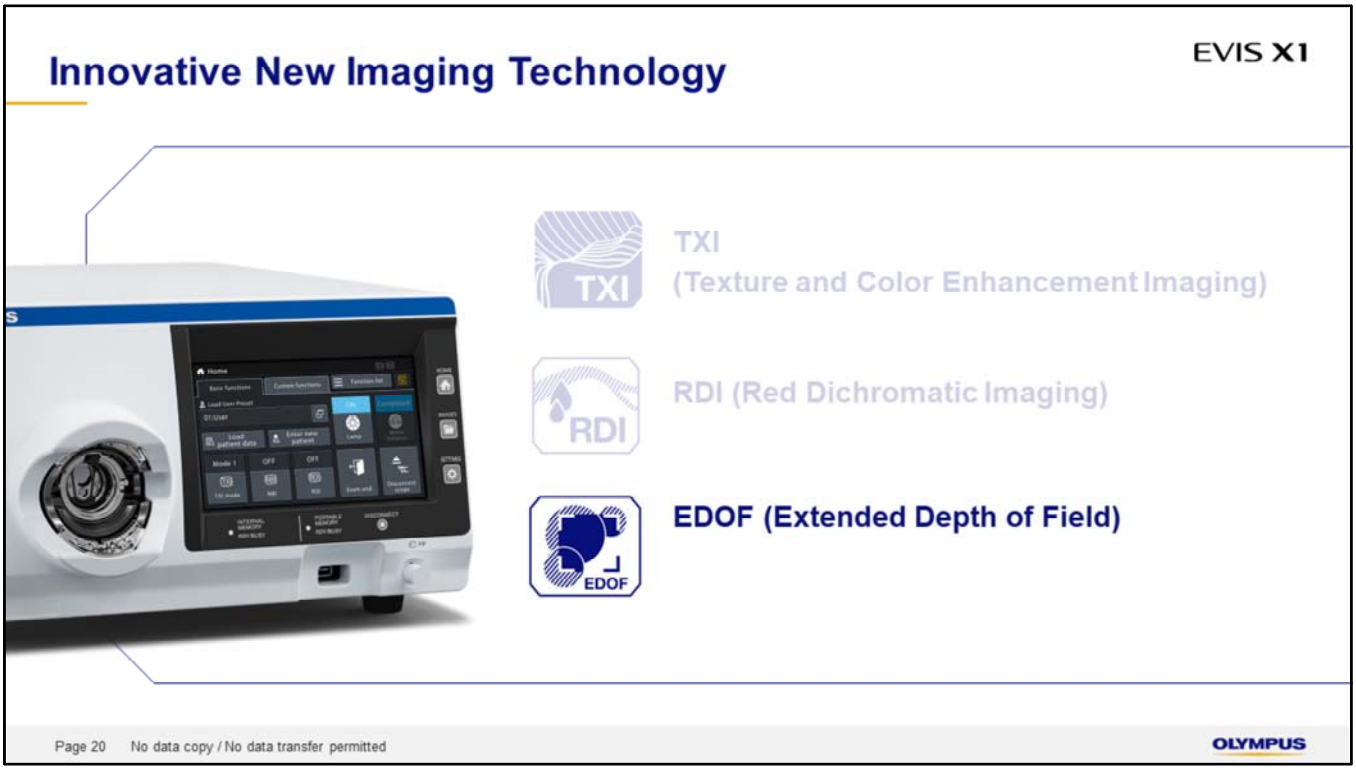
- In normal light observations, blue, green, and red light is emitted.
- In RDI, green, amber, and red light is emitted.
- Due to the lack of a blue component, slightly yellowish images like this are captured.
- RDI takes advantage of the fact that amber light is easily absorbed into the blood.
- The effect can be obtained by independently emitting amber light.
- Let me explain the principle using the next slide.



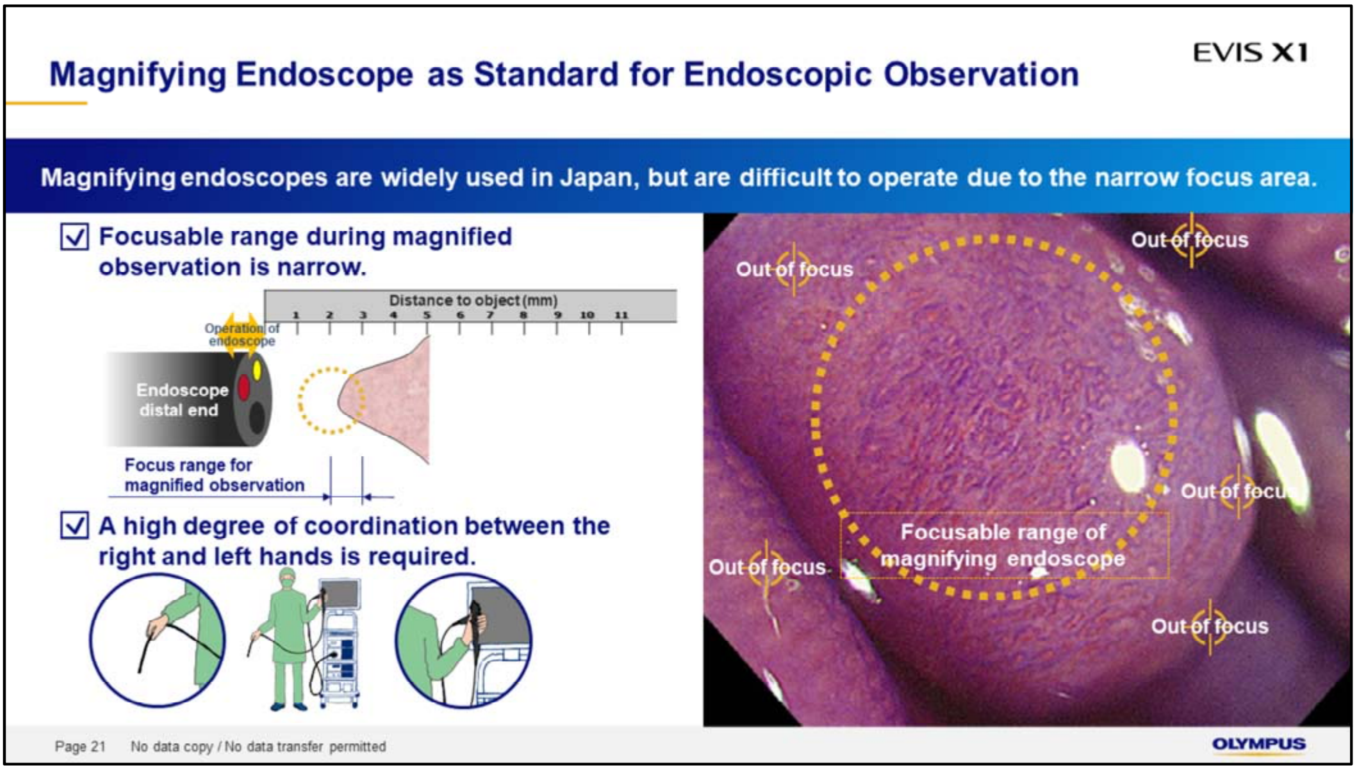
- In this way, of the red, amber, and green light emitted, red and amber light with longer wavelengths reach deep into the mucosa. These two colors differ greatly in the absorption of hemoglobin in the blood. Specifically, amber light is absorbed more by hemoglobin and red light is absorbed less.
- In these deep vessels, amber light is strongly absorbed and less light returns to the surface.
- In the absence of blood vessels, however, this absorption does not affect the return of light to the surface.
- In other words, the intensity balance of red light and amber light returning to the surface varies depending on the presence or absence of blood vessels.
- This difference is visualized to show deep, large blood vessels.



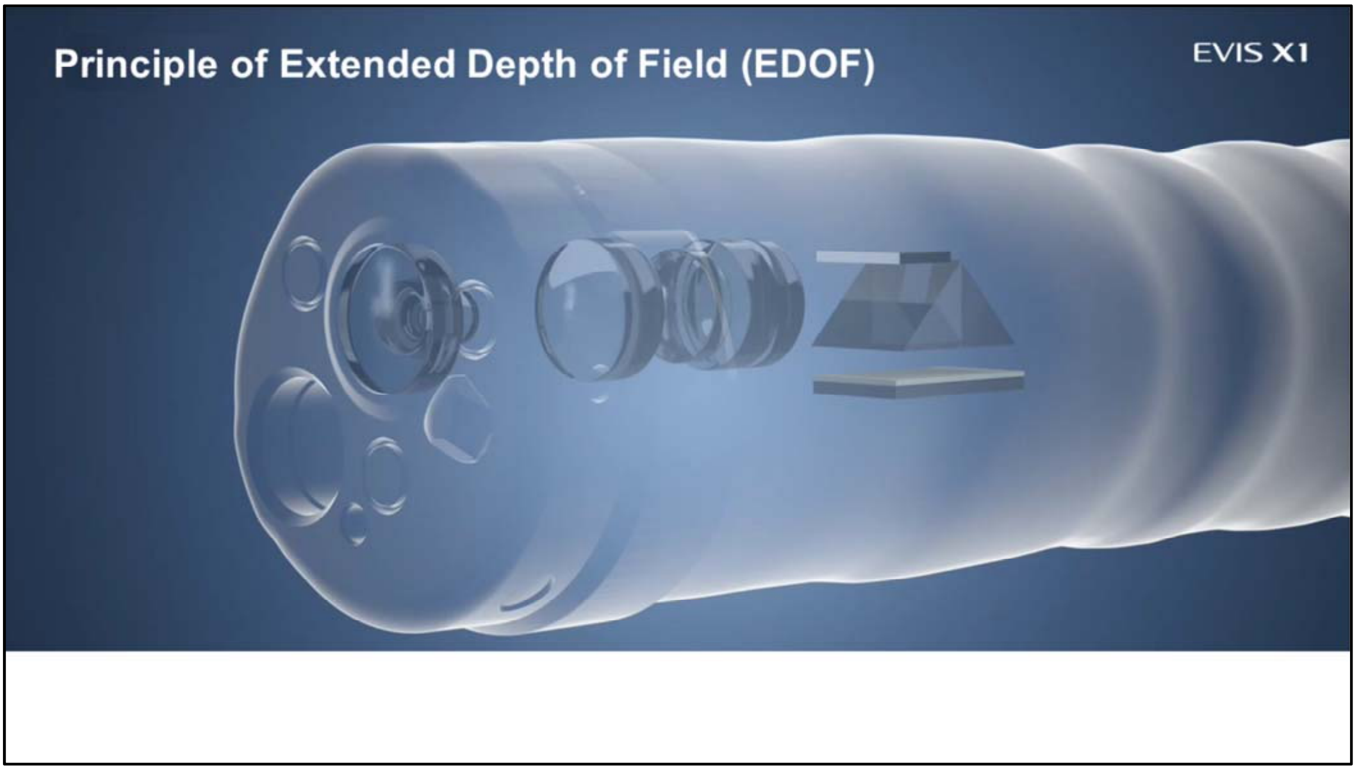
- Let’s look at the second effect of RDI.
- As shown in the slide, when bleeding occurs during endoscopic treatment, the affected area is rinsed with water to stop bleeding.
- However, the entire area turns red and it is very difficult to find the bleeding area.
- We believe that RDI is effective in such situations.
- When the blood is diluted with water to rinse the affected area, amber is hardly absorbed because of the low hemoglobin concentration.
- However, bleeding blood has a high hemoglobin concentration. Thus amber is absorbed well.
- Even if the red parts look almost the same, this difference can be highlighted with image processing technology, and the bleeding area can be highlighted like this.



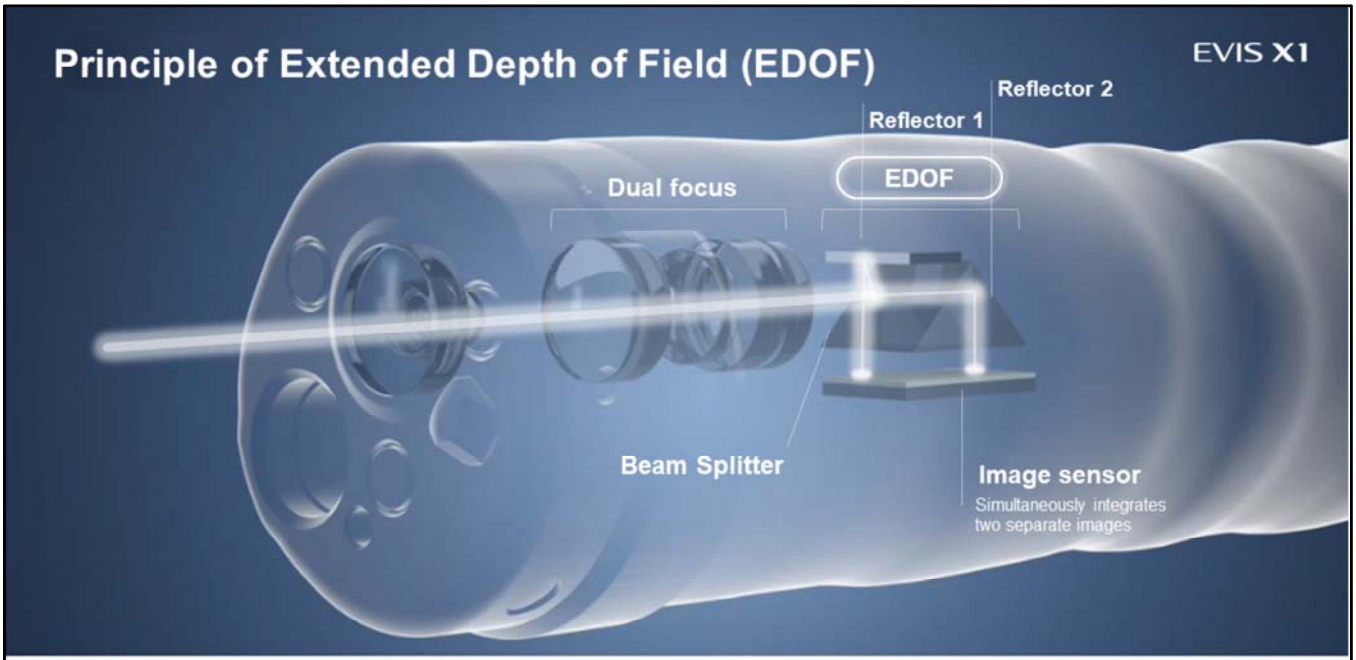
- I would like to move on to EDOF (extended depth of field) technology.
- EDOF is a technology that creates an image that is in focus from close to far.
- This technology synthesizes and displays two images at different focus distances in real time, making it easier to focus, reducing screening time, improving screening efficiency, and contributing to high-precision image diagnosis.
- This technology consists of image processing technology and an optical unit mounted on the endoscope, and demonstrates its features in combination with the endoscope dedicated for the EVIS X1.



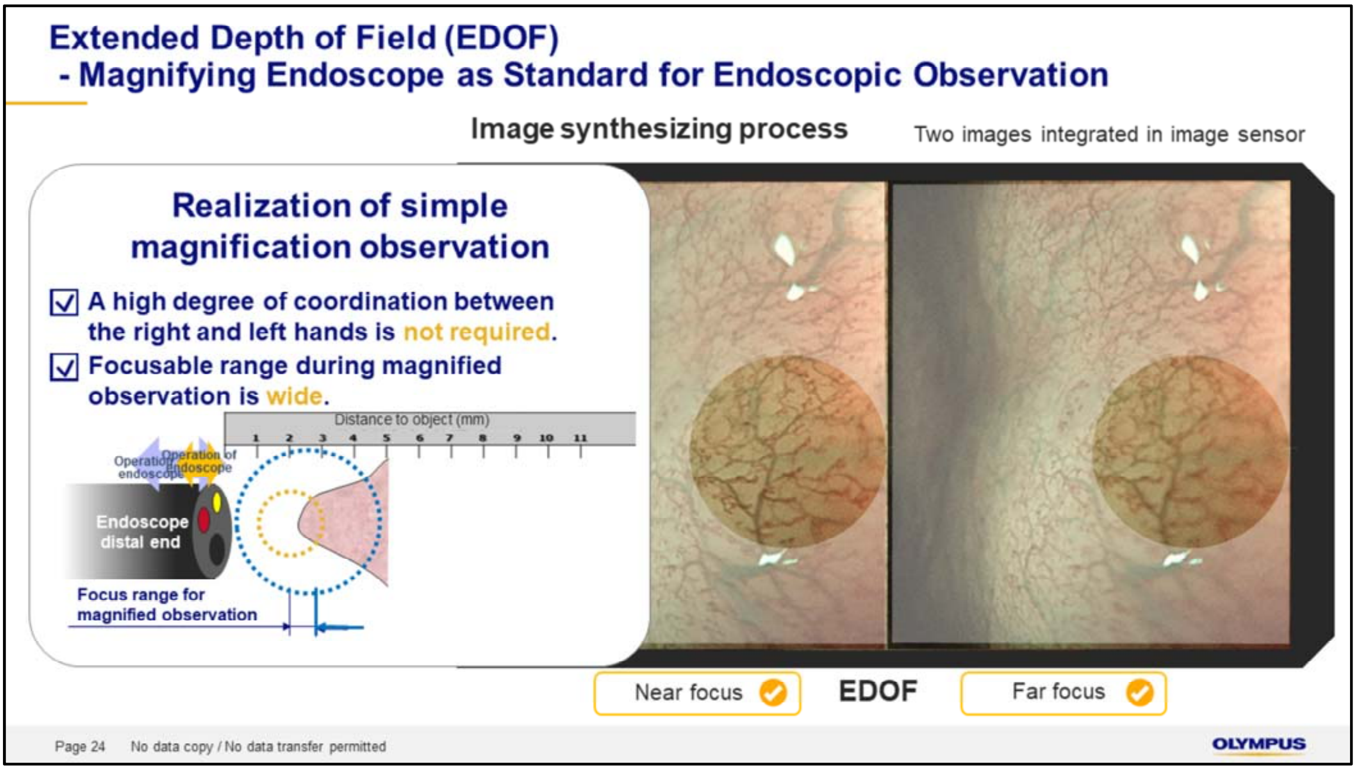
- We believe that EDOF can contribute to the standardization of magnified observation.
- Magnifying endoscopes are widely used, primarily in Japan, as a tool for accurate diagnosis of the depth of cancer invasion prior to endoscopic treatment.
- However, magnifying endoscopes have a weakness in that the range of focus is narrow as a trade-off for increasing the observation magnification and the image quality.
- This causes the problem of being difficult to focus properly over the entire screen when observing large and elevated lesions.
- To solve this problem, “endoscopists with skilled and advanced endoscope operation techniques” were needed.
- This has been a major obstacle to the global adoption of magnifying endoscopes, which are useful diagnostic tools.



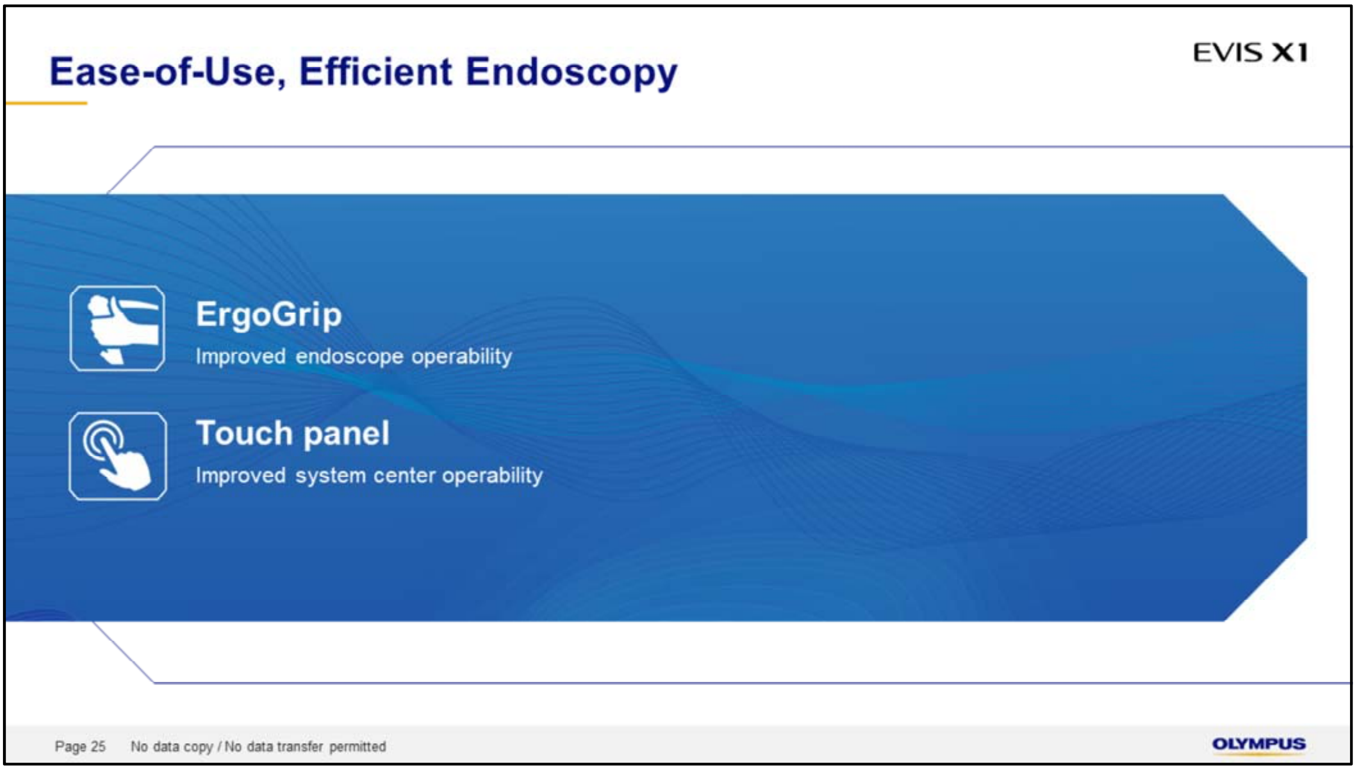
- We believe that the technology that overcomes this obstacle is EDOF.
- This is a schematic representation of the GIF-EZ1500 optical unit with EDOF.
- In this way, the light taken from the lens in the endoscope distal end is split into two paths by a newly developed prism unit and simultaneously integrated in one image sensor.
- By making a slight difference in the length of the light paths in this process, an image that is in focus at a near point and an image that is in focus at a far point are simultaneously produced for the same object.



- EDOF is a technology consisting of optical technology that captures two images at different viewing depths and high-speed image processing technology that synthesizes the focused parts of two images and outputs them as real-time video.
- Let’s look at the actual processing operation.



- This is how two images are integrated in the image sensor.
- If you look closely at these two images, you can see that one of them is blurry.
- By selecting differences between the two images and synthesizing the images of the unblurred parts, an image that is in focus from the near point to the far point or an image with a wide viewing depth can be created.
- This is EDOF technology.
- In this way, it is possible to widen the range of focus while maintaining the high observation magnification.
- This makes the focusing operation easy.
- Operation of the magnifying endoscope, which has been previously considered difficult, is improved to provide user-friendly magnifying endoscopes.
- Through these efforts, we hope that diagnosis using magnifying endoscopse will become the global standard.



- Ease of use was improved on both the endoscope and the system center.
- Both aspects are covered in the following demonstration video.

Let's Be Clear: Demonstration (Video)

EVIS X1

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- Let’s look at the EVIS X1 introduction video.
- You can confirm actual clinical evaluation results of the functions that will be covered in Dr. Inoue’s presentation next.

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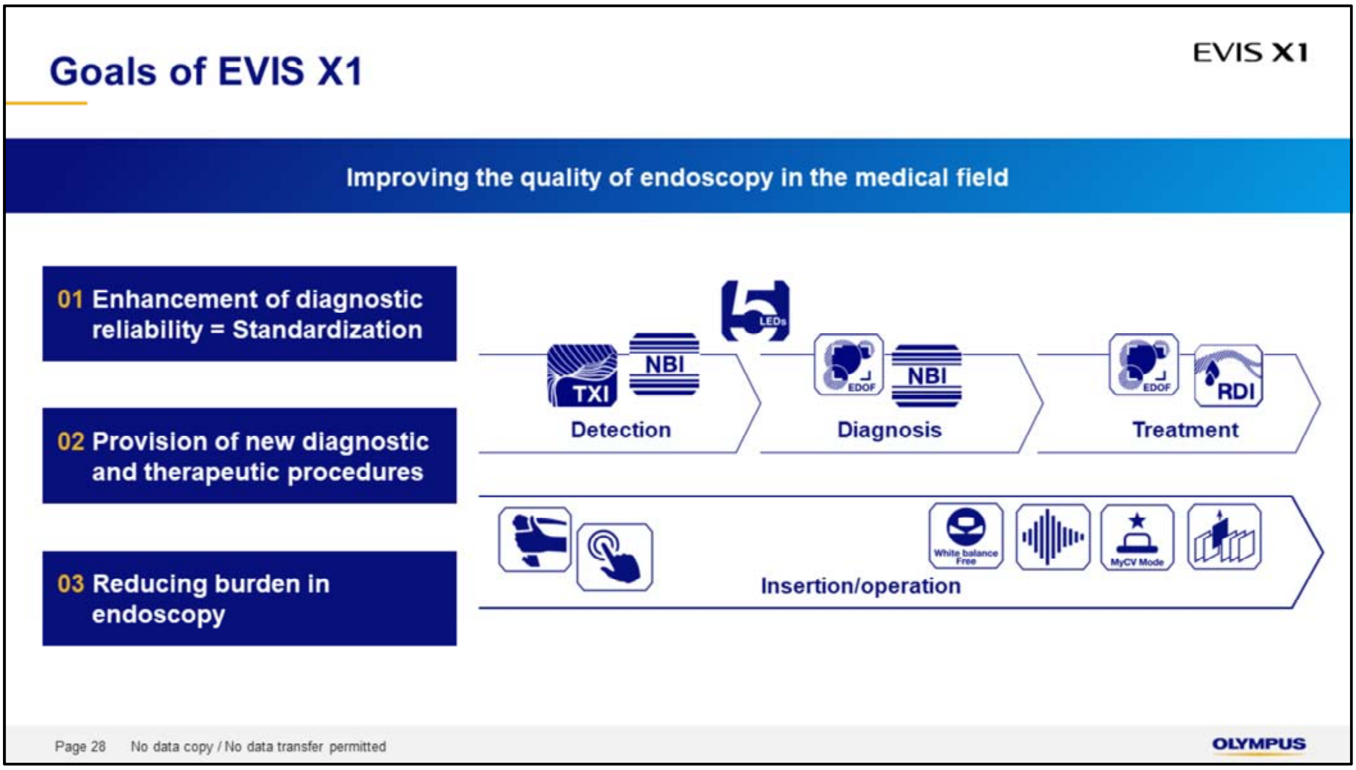

- As I mentioned in the introduction, “EVIS X1” was developed to achieve three goals.
- The new features of the EVIS X1 that achieve these goals are expected to be effective in various situations in endoscopy.
- As a result, we believe that the functions and technologies adopted for the EVIS X1 will contribute to improving the quality of endoscopy.

- Thank you for listening.