R/F

Using DeEP* Device Enhancement Processing Technology for ERCP

* Please contact us to check the availability of DeEP in your country.

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1. Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) is a procedure that injects contrast medium via a contrast catheter into the bile and pancreatic ducts that exit into the duodenum at the papilla of Vater. ERCP is commonly used to diagnose bile duct cancer and pancreatic cancer, treat obstructive jaundice, and remove common bile duct (CBD) stones.

Many types of devices are used in ERCP procedures, including ERCP cannulas used to introduce contrast medium for contrast radiography of the bile and pancreatic ducts, guidewires to assist with device insertion, dilating balloons to expand narrow ducts, baskets to crush CBD stones, stone retrieval balloons and baskets to remove crushed stones, and plastic or metal stents for obstructive jaundice. Thus, ERCP procedures are essential for the diagnosis and treatment of many biliopancreatic disorders. ERCP procedures are for the most part performed under fluoroscopic guidance, hence accurate diagnosis and treatment would be difficult without high quality fluoroscopic images of ERCP devices, even if improvements are made to these devices. For this reason and due to increasing controls on radiation exposure in recent years, when our Department of Endoscopy was relocated and expanded with the construction of a new outpatient building in 2020, a SONIALVISION G4 LX edition (SONIALVISION G4 LX) R/F system that offers both low dose levels and high image quality was procured for the new fluoroscopy room.

2. Department of Endoscopy, The Jikei University School of Medicine

The Department of Endoscopy in our hospital started in 1986 as the second established Department of Endoscopy in university hospital in Japan. Today, the Department of Endoscopy provides clinical education under the supervision of Professor Kazuki Sumiyama. The newly constructed outpatient building was furnished with 10 private endoscopy rooms, which included one fluoroscopy room. All endoscopy rooms are negative pressure rooms (two with HEPA filtration), and a recovery room with 18 beds in total is centrally managed and separated into individual booths **(Fig. 1)**.

The SONIALVISION G4 LX was selected for the new fluoroscopy room because of the size of the room and the compactness of the control system **(Fig. 2)**.

In 2019, the SONIALVISION G4 LX was used to perform 1,193 biliopancreatic procedures and continues to perform reliably to this day. ERCP with

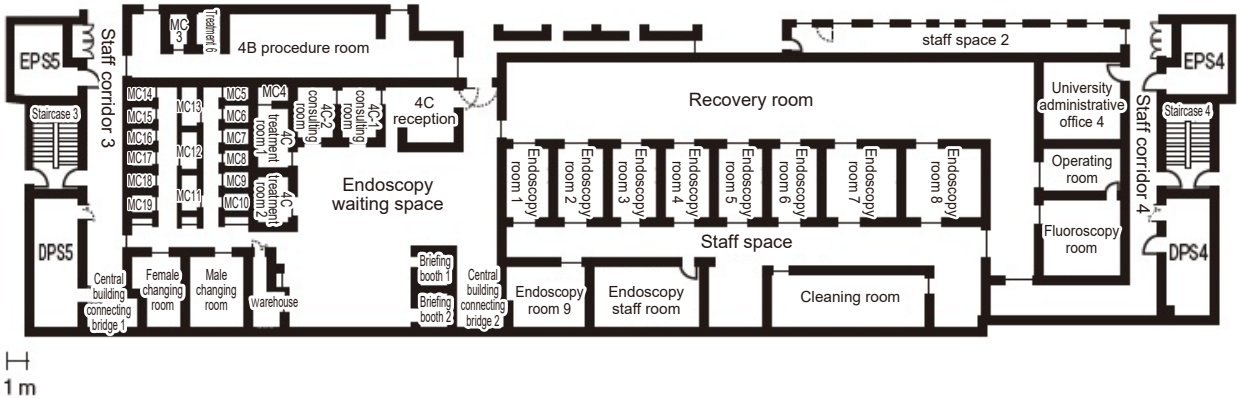


Fig.1 Department of Endoscopy Floor Plan

fluoroscopic imaging accounted for 504 of these 1,193 procedures.

3. Device Enhancement Processing (DeEP)

Our SONIALVISION G4 LX multi-purpose R/F system is equipped with the SCORE PRO Advance fluoroscopic image processing engine for low dose levels and image quality suitable for many different examinations. SCORE PRO Advance is a fluoroscopic image processing technology originally developed by Shimadzu for angiography systems that offers motion tracking-based noise reduction **(Fig. 3)** and object extraction-based edge enhancement that selectively enhances object edges based on their geometric structure **(Fig. 4)**. These features improve noise reduction and the visibility of detailed structures over previous image processing without lags in displaying images and with minimal lag images from inter-frame processing. With these image quality improvements, SCORE PRO Advance produces the same image quality with just 40 % of previous X-ray dose levels. The significant lag reduction provided by SCORE PRO Advance also minimizes loss of visibility at low pulse rates, allowing pulse rates to be reduced for even lower dose levels depending on the examination and type of procedure. The selective enhancement abilities of the object extraction-based edge enhancement feature of SCORE PRO Advance are further strengthened by an additional feature called device enhancement processing (DeEP), which improves the visibility of different types of devices at the same fluoroscopic X-ray dose levels as before. The degree of device enhancement provided by DeEP can be selected based on the type of ERCP procedure, improving the visibility of guidewires, metal stents, and stone-removing baskets as well as the visibility of guidewires within contrast medium and devices overlapping bone structures.

4. ERCP Cases Using DeEP

Case 1

A case of localized benign bile duct stricture was treated by placing a metal stent at the region of

Fig.2 SONIALVISION G4 LX and Control Console

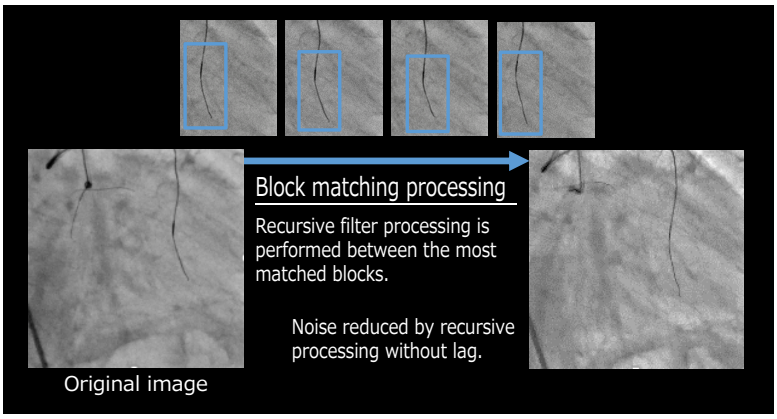


Fig.3 Motion Tracking Noise Reduction

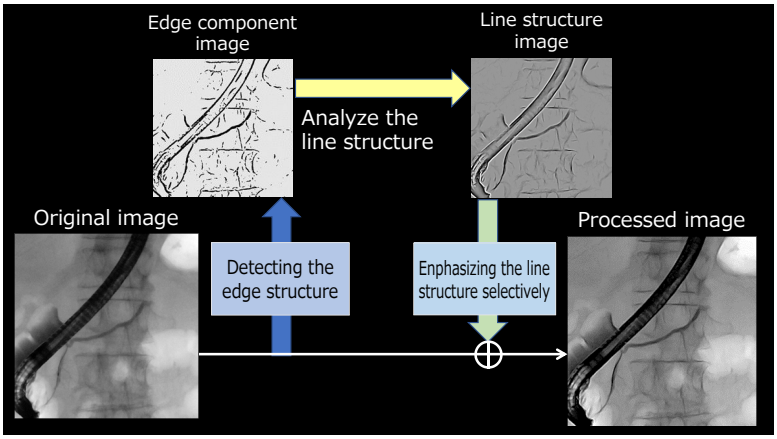
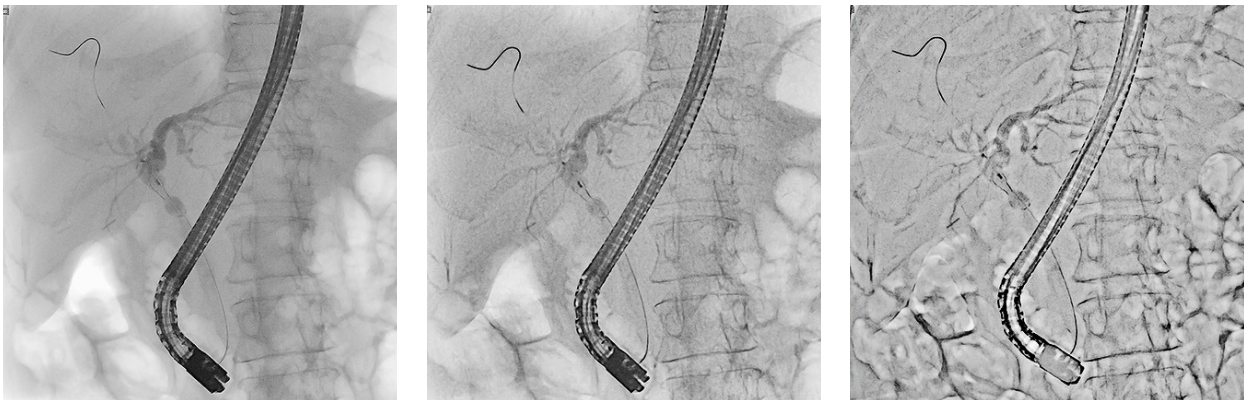


Fig.4 Object detected Edge Enhancement

stricture. Using DeEP allowed for a clear view of the entire stent, ensuring the stent remained in the optimum location during deployment **(Fig. 5)**. The view magnification feature was particularly useful during stent deployment **(Fig. 6)**, as it gave the operator clear images to reference when making fine adjustments to the position of the stent. The stent used in this case was a 10 mm × 3 cm BONASTENT M-Intraductal with a dumbbell-like shape marketed by Medico's Hirata Inc.

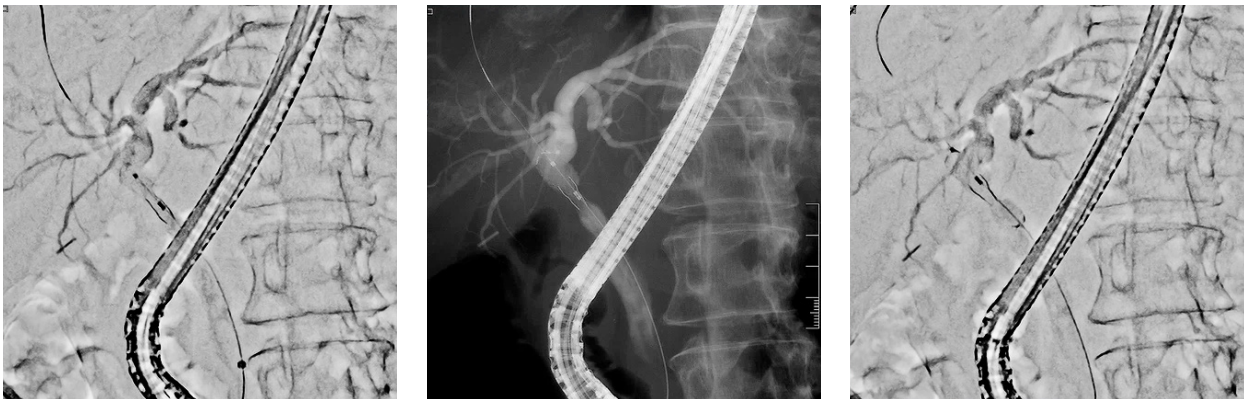
Case 2

A patient was referred to our hospital with recurrent pancreatitis due to incomplete pancreas divisum. Following a minor papillotomy, a pancreatic duct stent was inserted from the accessory pancreatic duct. In the past, pancreatic stents were not visualized clearly, but DeEP made the peripheral end of the stent easier to distinguish and ensured a successful stent placement **(Fig. 7)**. The pancreatic stent used was a 7 Fr × 8 cm pigtail plastic stent



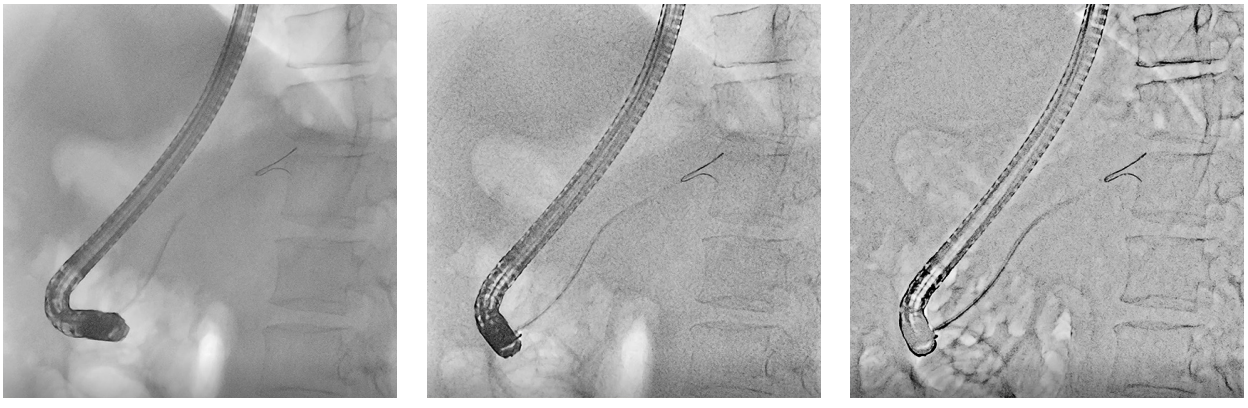
Normal　　DeEP (Low)　　DeEP (High)

Fig.5 Placement of metal stent at localized benign bile duct stricture. Using DeEP for a clear view of the entire stent.



DeEP (High)　　Radiograph (DR)　　DeEP (High)

Fig.6 Field magnification image provides a clear view of the stent position during deployment.



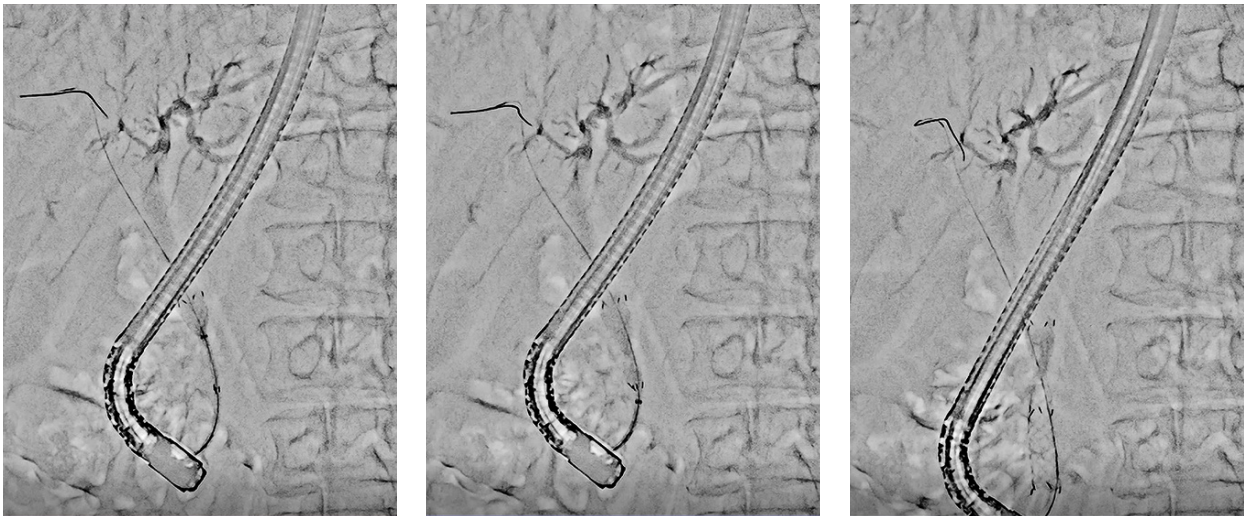
Normal　　DeEP (Low)　　DeEP (High)

Fig.7 Using DeEP for a clearer visualization of the peripheral end of the pancreatic stent.

(Zimmon Pancreatic Stent Sets) marketed by Cook Medical Japan.

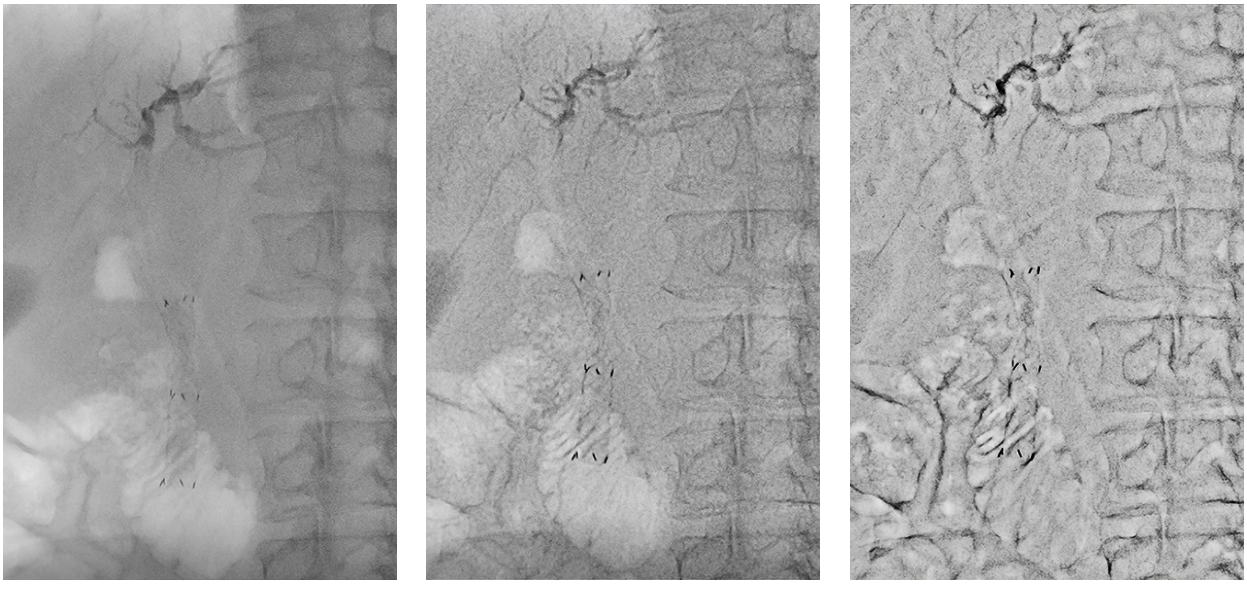
Case 3

A metal biliary duct stent was placed for obstructive jaundice caused by sclerosing cholangitis. DeEP made it easy to determine where to commence stent deployment and to confirm the state of stent deployment **(Fig. 8)**. The stent used was a 10 mm × 6 cm fully covered metal stent (HANAROSTENT Biliary Full Cover) marketed by Boston Scientific. When ascertaining the final morphology of the deployed stent, the high-contrast DeEP setting (DeEP (High)) provided a relatively clear visualization of the positional relationship between the stent and the intestinal tract **(Fig. 9)**.



DeEP (High) DeEP (High) DeEP (High)

Fig.8 Placement of a metal biliary duct stent for obstructive jaundice. Using DeEP for easy determination of where to commence stent deployment and verification of stent deployment.



Normal DeEP (Low) DeEP (High)

Fig.9 Using DeEP (High) to ascertain the final morphology of the deployed stent.

5. In Summary

Revision of the “Regulation on Prevention of Ionizing Radiation Hazards” by the Ministry of Health, Labour and Welfare Japan has resulted in stricter controls on dose exposure levels. In this context, the SONIALVISION G4 LX equipped with SCORE PRO Advance can provide high image quality at low dose levels, and in our experience, DeEP device enhancement processing also improves visualization during ERCP procedures. Nevertheless, several issues remain unaddressed, such as some devices still lacking visual clarity and inadequate processing of lower priority structures such as air and bone. We look forward to seeing what further improvements can be made to the equipment.

Reference

1) Tasuku Saito, Development of the SONIALVISION G4 LX edition, MEDICAL NOW, No. 87, 30-34, 2020