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SHIMADZU

CONTENTS

This booklet is a digest version of MEDICAL NOW No.89 (Published in September 2021), which is issued for Japanese medical professionals.

Current Medical Care and Approaches to COVID-19, and the Benefits of a Shimadzu Mobile X-Ray System

— Osaka Prefectural Nakakawachi Emergency and Critical Care Center —

In March of this year (2021), Osaka Prefectural Nakakawachi Emergency and Critical Care Center acquired the MobileDaRt Evolution™ MX8 Version c type (hereinafter, "MX8"), a Shimadzu mobile X-ray system, and has since been using it to treat patients with severe COVID-19. We asked center director Hitoshi Yamamura, chief radiological technologist (R.T.) Hideki Mikami, assistant chief R.T. Kenji Nakamura, and lead R.T. Daigo Wada about their approaches to COVID-19 medical care, how they use the MX8, and what effects MX8 has had on COVID-19 medical care.

(Interviews performed on June 21 and 24, 2021)

Hitoshi Yamamura, Center Director

Interview with Hitoshi Yamamura, Center Director

—Please describe your facility.

Osaka Prefectural Nakakawachi Emergency and Critical Care Center is the only tertiary emergency care center in the Nakakawachi medical district, which encompasses Higashiosaka City, Yao City, and Kashiwara City. Higashiosaka City houses numerous backstreet workshops and is crossed by multiple expressways, so the center sees a large proportion of trauma cases. Before the COVID-19 pandemic, the center admitted approx. 1,000 to 1,200 patients per year, of whom one-third were trauma cases, one-fourth were cardiac arrest cases, and the remaining patients included drug poisoning and pneumonia cases. The policy adopted during the COVID-19 pandemic was that cases within Osaka Prefecture would primarily be treated in critical care centers, hence this center has been providing care to patients from outside its medical district for the past 1 to 2 years.

Osaka Prefectural Nakakawachi Emergency and Critical Care Center, the only tertiary emergency care center in the Nakakawachi medical district

—What is the current situation at your facility regarding the COVID-19 pandemic, and what approaches are you taking?

First Wave: Finding our Feet

Since accepting our first case of COVID-19 on April 2 of last year (2020), the center has taken in 172 severe COVID-19 cases that required mechanical ventilation.

During the first wave, the center treated 13 severe cases and 2 of our 8 ICU beds were operated as negative pressure rooms. As the number of cases increased, we switched to operating all 8 beds under negative pressure.

The center was finding its feet at the time in dealing with various problems, such as area zoning between

COVID-19 treatment areas and other areas in the hospital, and obtaining personal protective equipment for infection control. Also, PCR testing was only available through the government at the time and the government was cooperative, but since nearby Higashiosaka City Medical Center obtained PCR testing equipment, we have coordinated with them on diagnosing COVID-19. The initial State of Emergency caused a slight reduction in severe cases during April and May of 2020, but as the only tertiary emergency and critical care facility in the region, we also needed to maintain local emergency services, and for a period of 1 year we continued to provide emergency medical services alongside treatment for severe COVID-19 cases.

All 8 ICU beds converted for negative pressure operation due to the pandemic

Second Wave: The Center Commences PCR Testing In-House

The second wave reached its peak around the middle of August and the center took in around 25 COVID-19 patients during this period. The challenge at the time was providing medical care for both COVID-19 and heat stroke, as the center was receiving suspected COVID-19 cases based on fever caused by heat stroke who had nowhere else to go. A shortage of personal protective equipment also became a problem over this period with the center purchasing protective clothing intended for painting applications. Nonetheless, we also made the necessary arrangements to perform PCR testing in-house and commenced testing from around the end of June. This allowed us to diagnose COVID-19 in-house without having to rely on other medical institutions or the government.

Third Wave: Converting the ICU, General Ward, and Treatment Areas into Negative Pressure Areas

A shortage of beds became a problem during the third wave. Emergency cases of cerebral infarction, myocardial infarction, and pneumonia increase through fall and winter. During the 5-month period from November through to March, we treated around 70 such cases. Over the new year period at the peak of the third wave, the prefectural government requested we increase the number of beds being used to treat severe COVID-19 cases. As doing this would leave the center unable to handle the increased number of normal emergency cases, we balanced providing normal emergency services while also dedicating 8 ICU beds to severe COVID-19 cases.

Foreseeing that COVID-19 would continue into the future, from November through to January the center undertook renovation work to create negative pressure rooms. All ICU rooms were converted, as were 9 of 22 general ward beds (among 8 HCU beds and 14 general beds). Treatment areas that are entered by patients such as the emergency room, the CT room, angiography room, and operating room were also converted. Performing renovation work in all ICU rooms and 70 % to 80 % of treatment areas while also continuing to treat severe COVID-19 cases was a difficult task, but undertaken for the protection of patient and staff safety.

Nine of 22 general ward beds converted to negative pressure rooms

Fourth Wave: Strengthening Medical Care Systems by Acquiring a Shimadzu Mobile X-Ray System

The fourth wave saw a sudden increase in cases from March of 2021 in Osaka Prefecture, where the number of severe cases grew to over 450, which was far above the 220 beds secured by the prefectural government. This created a situation in which hospitals that normally only accepted moderate cases also started treating severe cases, and a worsening situation among patients staying at home due to a lack of hospital beds, some of whom were brought to us after cardiac arrest. As reported in the news media, Osaka was unable to provide adequate medical services.

At around this time, facilities that had been designated by the prefectural government as dedicated COVID-19 hospitals were not providing normal emergency medical services, and so during the third and fourth waves, there were substantially fewer facilities to

handle emergency cases. As a facility that provided emergency medical care, our center was treating both emergency cases and severe COVID-19 cases transported from outside our medical district in Osaka City. To date, the center has treated 170 severe COVID-19 cases while also accepting close to its usual number of emergency cases, and operations at the center remain strained to this day.

Nonetheless, during the fourth wave, the center both established negative pressure rooms and strengthened its medical systems by acquiring a Shimadzu mobile X-ray system. The Shimadzu mobile X-ray system is used to perform radiographic examinations on severe COVID-19 cases in the ICU, and when replacing endotracheal intubation tubes and central venous catheters. The mobile X-ray system is extremely helpful as it enables us to check the acquired images, perform procedures, and make decisions on image retakes at the bedside.

By contrast, the doctors, nurses, radiological technologists, and other medical staff at the center remained almost unchanged for one year after the first wave. As the center has just 30 beds in total and a relatively small contingent of medical staff, not being able to receive support from staff in other wards or rotate staff between wards has been a challenge.

A Disconnect between Health Care Facilities and the Public Arena

Earthquakes and other disasters have a massive impact on one's visual surroundings and information on such disasters travels quickly, but with COVID-19, there was a huge disconnect between the situation in the public arena and on the ground in medical facilities. I think this gap increased the psychological strain felt by medical professionals and needed to be overcome in order to reduce the flow of people.

—What do you hope to see from medical equipment manufacturers like Shimadzu?

I believe Shimadzu has released a PCR testing system[*1]. The COVID-19 situation could resolve itself or new variants may continue to emerge every year. If COVID-19 remains a problem, I think we will see an increased need for more accurate antigen tests that are simple and require no sample pretreatment, and for PCR testing systems that provide results in 30 or 45 minutes. The medical equipment that does this should provide immediate diagnosis after testing at the medical facility, and also be capable of testing for potential variants that may emerge in the future. Therapeutic drugs that provide options for earlier therapeutic intervention also need to be developed.

—What would you say to facilities that are struggling with treating COVID-19?

We do not know what the future holds in terms of medical care and this infectious disease. We also cannot predict what effect variants will have even after vaccination, so we should focus on providing treatment for COVID-19 in tandem with other primary fields of medical care.

Department of Radiography Interview

—Please give us an overview of your radiography department.

Mikami The radiography department has 5 part-time and 5 full-time radiological technologists, including myself. Before we operated just one mobile X-ray system, but in March of this year (2021) the department acquired a Shimadzu MobileDaRt Evolution MX8 Version c type (hereinafter, "MX8") system and now operates two mobile X-ray systems.

Nakamura Before the COVID-19 pandemic, when we operated one mobile X-ray system, we performed on average 15 examinations each day almost every day. Now, the previous system is used in the operating room and emergency room on the first floor, and the MX8 is used in the ICU and hospital wards on the second floor.

—What were the events leading up to acquiring the MX8 and why did you choose the MX8?

Acquiring an MX8 for Operational Improvements

Nakamura We encountered problems operating just one mobile X-ray system. Radiography for inpatient cases with acute changes or after procedures on the second floor sometimes overlapped with radiography for emergency outpatients and during or after surgery, which required us to interrupt an examination to move the mobile X-ray system. Some situations prevent radiography from being stopped immediately, so we were considering placing a mobile X-ray system on each floor to improve efficiency and reduce patient stress.

Notes from the Editor

*1 PCR testing system: Shimadzu's AutoAmp™ gene analysis system that offers fully automated PCR testing was released in November 2020 (only available in Japan as of Sep. 2021)


Chief R.T. Hideki Mikami


Assistant chief R.T. Kenji Nakamura


Lead R.T. Daigo Wada

Mikami Then the sudden increase in mobile radiography work due to the COVID-19 pandemic prompted us to acquire the second system.

Nakamura Performing radiography in COVID-19 cases takes three times as long as normal radiography; the equipment must be prepared against transmission for each patient and cleaned both during and after the examination. Emergency and critical care centers are always in a race against time, but this workflow prevented a rapid response when a mobile X-ray system was needed on the first floor. As both the first and second floors have only severe cases, a major improvement of acquiring the MX8 was the ability to perform radiography quickly on both floors.

Large Monitor and Slim Body: Designed for Practicality in Medical Settings

Nakamura The MX8 was chosen for its large on-board monitor and slim body design. Being an emergency and critical care center, we immediately proceed to diagnosis and treatment after radiography so a large on-board monitor was essential. Although sites for examination can be localized on a small screen, doctors find it difficult to verify information in detail. Space at the bedside is also very limited, so we chose the MX8 because it was the slimmest system available and very maneuverable.

Wada I also thought the Auto-Power-Off function[*2] and Inch-Mover buttons[*3] were good features.

Mikami Looking at the changes to MobileDaRt, they seem to have made it more practical. With the collapsible column and pockets on the main unit to store equipment, it looks like some thought has been put into how the system will be used in a medical setting.

—Could you tell us how you use the MX8?

Introducing Detailed Infection Control Measures into Patient Rounds, Radiography Workflows, and Radiography Procedures

Wada In rooms with COVID-19 cases, radiography is performed with three people: one MX8 operator, one radiological technologist acting as an assistant, and one nurse. The assistant and nurse are responsible for handling the patient, such as lifting the patient from either side to place an FPD, and the operator is only responsible for system operation and does not touch the bed or the patient. Duties are evenly rotated among all 5 radiological technologists, including the chief radiological technologist. Radiological technologists are also on watch 5 or 6 times per month, and the person on watch that day takes the role of assistant, which the day shift technologist takes the role of operator.

In terms of workflow, hospital room radiography orders are transmitted from the RIS to the mobile X-ray system as an appointment list is simultaneously printed out every morning. The site for examination and exposure conditions are also included on the appointment list. We then move to the second floor where the MX8 is located.

After entering the room, lead glass panels are first placed on either side of the bed. The assistant and nurse don personal protective equipment that includes, from top to bottom: hat, goggles, N95

Notes from the Editor

*2 Auto-Power-Off function: Turns off power to the main unit after a prescribed period without operation.

*3 Inch-Mover buttons: Buttons on the front of the collimator that move the system forward and backward

mask, plastic apron, and nitrile gloves.
The MX8 operator reads the patient bar code ID, checks that the site for examination received from the RIS matches the details in the appointment list, then adjusts exposure conditions for each patient as printed on the appointment list. Next, the MX8 is moved to the bedside and the operator extends the arm to a position where it can be operated by the assistant. The assistant performs positioning by only touching the collimator and irradiation field knobs whenever possible. When positioning is complete, the operator times radiography based on the respiration of patients on mechanical ventilation and aims to perform radiography when no other staff are in the surrounding area. After checking the images, the operator transmits the images to PACS.
The FPD is wrapped in two plastic bags as an infection control measure. The outer plastic bag is changed for each patient and the inner plastic bag is cleaned with alcohol along with the collimator and irradiation field knob touched by the assistant. All personal protective equipment apart from the mask and hat is also replaced between patients. Undertaking these measures for every patient lengthens radiography to take three times as long compared to patients who require no special infection control measures.
COVID-19 cases have a scheduled morning examination consisting of chest radiography once a day, apart from Mondays when both chest radiographs and abdominal radiographs are taken. When beds are full, this entails all 10 patients performing 20 radiographic examinations. After including non-COVID-19 patients, about 25 examinations are performed in total, which takes around 1 hour 30 minutes. Apart from scheduled examinations, radiography is also used during the day shift to confirm the position of endotracheal intubation tubes after reinsertion or repositioning, to confirm feeding tube insertion, or after replacing a central venous catheter. Radiography is also used when patients develop acute changes. Images may be acquired 3 or 4 times from the same patient in a day to replace and confirm the position of an intubation tube.


Thanks to the collapsible column, the system can even be stored under shelving.

Mikami Each examination requires the donning of personal protective equipment and other infection control measures and it takes time, which means unscheduled examinations are performed at around midday.

Wada We also take steps to ensure early notification from doctors and nurses before an intubation procedure and set up the FPD accordingly in preparation.

Nakamura Given these working conditions, the ability to immediately check images at the bedside on the large MX8 monitor is extremely useful.

Wada Each person on night watch also adopts special infection control measures to be able to perform an examination efficiently even when working alone. For example, wearing two layers of gloves or covering the exposure switch with a plastic bag or cloth to disinfect it with alcohol.

Nakamura Our center has an ICT team[*4] that determines basic infection control measures, such as rules for entering ICU areas or for performing portable X-ray radiography. I believe that if each facility in Japan shared its procedures, these types of basic rules will become standardized.

MX8 with Features Optimum for both Emergency Care and the COVID-19 Pandemic

Wada If I forget to recharge the main unit battery after multiple emergency examinations, the MX8 has an Auto-Power-Off function that conveniently reduces power consumption from the main unit battery. Other staff members have also mentioned the Inch-Mover buttons make positioning easier, and the responsive exposure switch makes it easier to time image acquisition with maximal inspiration. I have also heard people comment the brightness of the monitor on the main unit makes examining reference images easier, the storage areas for the FPD and small objects are well thought out, and the surface coating and wiring are easy to clean and good for infection control. The collimator on the MX8 is also more compact and has less surface area to be wiped. Plastic bags and cleaning wipes can also be kept in the storage box while on rounds, a particularly useful feature during the COVID-19 pandemic.

Notes from the Editor
*4 ICT: Infection Control Team

During hospital rounds, plastic bags and cleaning wipes for infection control are stored in the rear storage box of the MX8 (left). A protective apron is also carried on a hanger from the hook on the support column.

From left: R.T. Okamiya, chief R.T. Mikami, lead R.T. Wada, assistant chief R.T. Nakamura, and R.T. Fujimoto

Nakamura In terms of moving the system and system operability, I have seen female radiological technologists in training using the MX8 with no apparent difficulty.

Mikami Maneuvering the MX8 is really quite easy. The smaller main unit also makes cleaning easier.

—What do you hope to see from medical equipment manufacturers like Shimadzu?

Wada It would be helpful if the FPD battery and barcode reader could be charged on the main mobile unit. I would like the mobile X-ray system to be able to receive exposure conditions after they are configured for each patient on the RIS, then apply those conditions automatically. Also, while the monitor display is flat and easy to clean, for infectious diseases it would be nice if all components could be cleaned with alcohol. We mentioned covering the FPD in plastic bags earlier, and it would be helpful if this could also be done in the FPD storage area.

Nakamura think remote equipment repairs will become more prevalent in the future and I would like to see it implemented as a feature. Even when repairs can only be undertaken on-site, I want logs to be collected remotely so on-site visits happen with some degree of readiness.

Mikami Eventually, I hope the service engineer and necessary components arriving at the facility simultaneously, allowing the engineer to complete repairs there and then.

—What would you say to facilities that are struggling with treating COVID-19?

Nakamura Medical professionals throughout Japan, including us, are still in the process of finding our feet, and we do not know if current practices are correct. Nevertheless, we cannot stop fighting the virus and must do the best we can.

Mikami Right now we are barely keeping our head above water, but this is exactly the time that calls for the greatest resolve.
We cannot afford to relax or lose sight of the significance of our work and must keep on fighting.

Osaka Prefectural Nakakawachi Emergency and Critical Care Center

3-4-13 Nishiiwata, Higashiosaka City, Osaka

- Hospital beds
  8 ICU beds (including 2 beds in private rooms with negative pressure management), 8 HCU beds, 14 general ward beds
- Medical departments
  General Surgery, Orthopedic Surgery, Neurosurgery, Intensive Care, IVR and Endoscopy

Vascular

Loving Everything about Trinias

Nobuhito Kaneko, M.D.

Limb Salvage Center, Kasukabe Chuo General Hospital
Nobuhito Kaneko

1. Introduction

The hospital was established in August of 1981 as Minami Kasukabe Chuo Hospital, then renamed Kasukabe Chuo General Hospital in 1998. One year before this renaming, the hospital obtained a coronary angiography system and ever since has been partly responsible for acute cardiovascular care in the eastern medical district of Saitama Prefecture.
In recent years, the hospital has treated an increasing number of patients with the peripheral arterial disease (PAD), and in 2017 the hospital established its Limb Salvage Center to provide comprehensive medical care for podiatric disorders. As well as catheter-based procedures, today the hospital also provides foot care, wound management, and surgical procedures for chronic limb-threatening ischemia (CLTI), along with multidisciplinary care using various adjuvant therapies. A distinguishing feature of the Limb Salvage Center is that it cares for patients with non-ischemic wounds as well as patients with PAD. The center accepts patients from outside its medical district and prefecture, and at any given time has 30 or more inpatients with intractable wounds. The center is also proud of the many times it has provided live demonstration on catheter-based procedures for large-scale conferences such as Complex Cardiovascular Therapeutics (CCT) and Japan Endovascular Treatment (JET).
In 2019, angiography systems in two rooms were updated and the center acquired a Trinias (12-inch) system for its No. 2 angiography room **(Fig. 1)**. I (the author) actually perform almost no percutaneous coronary interventions (PCI), normally a mainstay of cardiovascular specialists, but instead ply my trade with endovascular treatments (EVT). Around 2 years have passed since Trinias was installed, and almost all my catheter-based procedures are now performed using Trinias in the No. 2 angiography room. Image quality is excellent, as goes without saying, but a major reason for my preference is that Trinias is equipped with many useful applications for EVT. In this article, I would like to present images from real-world cases while describing the excellent features of Trinias, an angiography system I like enough to use for almost all my patients.

2. My Favorite Features

(1) SCORE RSM
(2) SCORE Chase
(3) Flex-APS (Diluted DSA)
(4) SCORE MAP (Trace MAP, Sketch Function)

(1) SCORE RSM

Whether it is coronary arteries or peripheral arteries, obtaining clear images is a prerequisite for interventional procedures and a topic of utmost importance. It is no exaggeration to say the skill and sensibility of an operator can be determined based on just one of their acquisition images.
Using conventional digital angiography (DA), which acquires live images, acquiring clear contrast-enhanced images of peripheral arteries is a challenge due to the effects of bone and the intestinal tract. Digital subtraction angiography (DSA) provides clearer images than DA because it can eliminate

Fig.1 Cardiovascular Department Staff and Trinias (Author: Leftmost on Front Row)

the effects of bone, which has made it very useful for procedures in peripheral arteries. Nevertheless, DSA is unable to eliminate the influence of intestinal peristalsis, and artifacts will occur in the aortoiliac region. DSA also requires a stationary examination table, hence a complete image of the lower extremities requires multiple acquisitions, thereby increasing the amount of contrast media administered and X-ray dose. Furthermore, many patients with CLTI are unable to remain stock-still during DSA due to involuntary movement and pain associated with intravascular osmotic pressures caused by contrast medium injection, and obtaining clear DSA images is difficult due to artifacts from this body movement.

SCORE RSM is a technology that reduces the effects of bone and the intestinal tract by creating low-frequency mask images from live images acquired during contrast-enhanced imaging and subtracting these mask images in real-time. SCORE RSM enhances only the contrast-enhanced vessels and can produce images similar to DSA while being unaffected by patient movement, even while moving the examination table **(Figs. 2 and 3)**. It also has the advantage of reducing the X-ray dose to about half that of conventional DSA.

Other than in specific cases, SCORE RSM is the first-choice imaging technique for EVT at our hospital, and DSA is only used to obtain information on fine vessels or to confirm vessel dissection after a procedure.

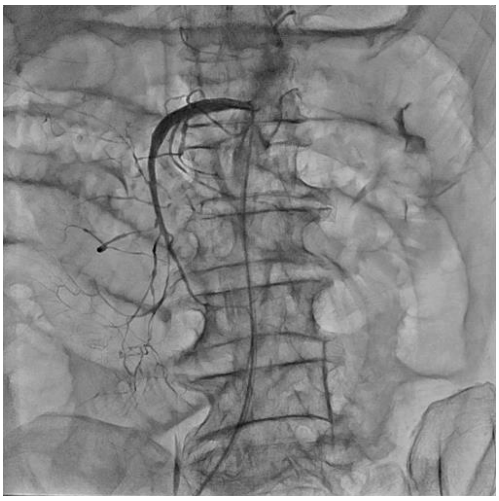

Fig.2 SCORE RSM image obtained after SMA intervention for abdominal angina. Good visualization of everything down to arterioles regardless of intestinal gas

Fig.3 Puncture of distal peroneal artery with SCORE RSM

(2) SCORE Chase

Unlike coronary arteries, regions with peripheral arteries cannot be captured entirely within a single field of view. Because of this, multiple images must be combined when creating slides and other materials of these regions, which is a painstaking task. Contrast medium concentration also varies depending on the time phase, hence creating a clear image has been extremely difficult.

SCORE Chase is an innovative application that automatically creates long-view images after an acquisition is complete and only requires the operator to press the Chase button and perform normal acquisition with examination table panning. The application is useful for procedures, but also highly valued because it reduces our workload **(Fig. 4)**.

Long-view DSA images can also be created by combining SCORE Chase with the SMART Table multifunctional catheterization table. The procedure for creating these images is as follows. First, image acquisition is performed with contrast enhancement as normal using SCORE RSM while examination table panning across the region of interest. Image acquisition is then repeated using the already-recorded table movements and without contrast enhancement. These non-contrast-enhanced images are then used to create mask images, which are then used to obtain subtraction images **(Fig. 5)**. Because this technology is capable of creating a DSA image of the entire length of the lower extremities with a single contrast media injected acquisition, it can reduce the amount of contrast medium used by about 80 % and reduce the X-ray dose by about 60 %. This makes the SCORE Chase application not only friendly to radiological technologists but also friendly to patients.

(3) Flex-APS (Diluted DSA)

PAD and especially CLTI is often coexisted by chronic kidney disease (CKD). Patients with conservative-stage CKD must be administered as little contrast medium as possible to avoid contrast-induced nephropathy (CIN), and it is also good

practice to limit the amount of contrast medium administered to patients who are undergoing maintenance dialysis to avoid volume loading. For these reasons, we often perform DSA with diluted contrast medium as reported by Hayakawa et al. for EVT[1]. Instead of diluting with physiological saline, I avoid volume overloading by drawing blood from the sheath and diluting contrast medium with this blood. When operating in the dilute medium mode, the injected contrast medium is almost iso-osmotic and there tends to be less patient movement associated with changing intravascular osmotic pressures. However, because diluted DSA needs greater enhancement of contrasts in the resulting images on the display monitor compared to conventional DSA, diluted DSA has the disadvantage of being more prone to artifacts from involuntary or other movements.

Fig.4 Contrast-enhanced image of arteries in both lower extremities with SCORE Chase

Fig.5 DSA image of Fig. 4

Flex-APS is an application that automatically corrects misregistration artifacts arising from body movement during DSA. By applying an appropriate correction to each pixel, Flex-APS can even correct for twisting motion that would be outside the scope of conventional motion correction. Another very convenient aspect of Flex-APS is that correction is applied in real-time, so corrected images with few artifacts can be observed during an ongoing examination. The ability to acquire clear images with few artifacts also provides the major benefit of fewer re-acquisitions, which further reduces the X-ray dose and amount of contrast medium used

The images Trinias acquires in the dilute medium mode are worthy of special mention. With non-Shimadzu systems, a rough sand-like grain is apparent in background areas of the image due to the processing they use to enhance contrast in the image, hence the dilute medium mode is kind on the patient's kidneys but not on the operator's eyes. The dilute medium mode of Trinias has no such issues; at a glance, images are accurate enough to be indistinguishable from normal DSA images **(Fig. 6)**.

Using undiluted contrast medium in the dilute medium mode also provides clear visualization of collateral blood flow and fine distal arteries such as those below the ankle, where detailed information is difficult to obtain with normal contrast enhancement **(Fig. 7)**. This technique is very effective in difficult EVT cases, such as for arteries below the knee in patients with CLTI.

(4) SCORE MAP (Trace MAP, Sketch Function)

Accurate procedure area determination is as important for EVT as for PCI. For example, inaccurate stent placement at the aortoiliac bifurcation and resulting displacement into the aorta will cause problems for subsequent procedures that manipulate wires or devices in the same area. Even in the femoropopliteal artery region, where patency is gradually improving due to the emergence of various therapeutic devices, if the area where the final device is used is narrower than the area that underwent lesion preparation, restenosis will be induced. Accuracy is also a requirement for stent placement at the origin of the superficial femoral artery (SFA). In below-knee arteries where long-term patency is not assured, there is a concern that unnecessary intervention may lead to future prolongation of the lesion.

Roadmap functions are extremely effective tools for performing accurate procedures. Other than

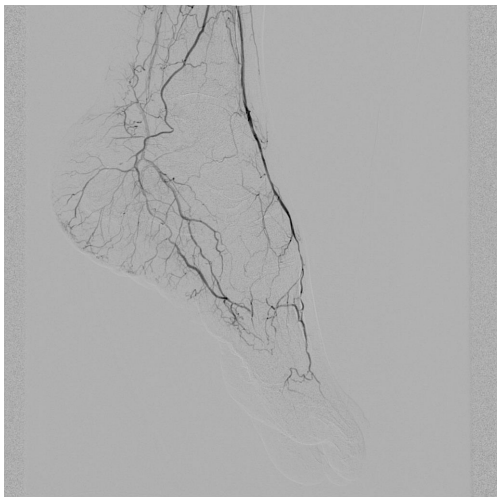

Fig.6 Contrast-enhanced image of a foot with diluted contrast medium. At a glance, the image is indistinguishable from a normal DSA image.

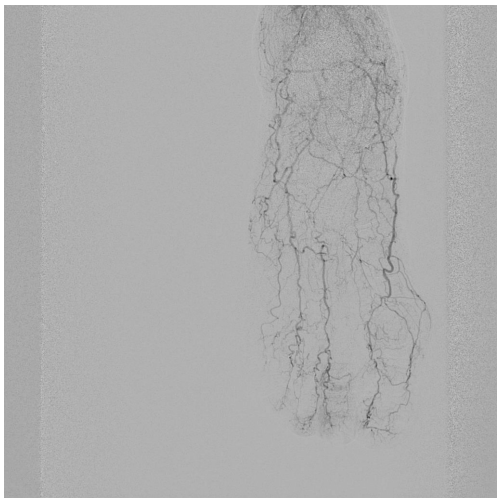

Fig.7 Dilute contrast-enhanced acquisition mode image with undiluted contrast medium. The main artery below the knee is occluded, but visualization down to peripheral arterioles is good.

procedure area determination, roadmap functions help when manipulating guidewires and can reduce contract medium usage and X-ray dose by reducing the number of times contrast injection is used. Previous roadmap functions had the drawback of turning the entire vessel lumen white, which had a negative impact on the visibility of guidewires and devices.

This problem has been resolved by Trace MAP. Unlike previous roadmap functions, Trace MAP automatically extracts just the vessel border from DSA images and overlays this outline onto fluoroscopic images without turning the entire vessel lumen white, which ensures guidewires and devices remain visible **(Figs. 8 and 9)**. Trace MAP also supports magnification and reduction of the field of view, hence the Trace MAP image can be displayed on the part of the image where it is needed. This is extremely useful because when a stent is being placed at the SFA origin, an overview image can be viewed before focusing on the bifurcation area **(Figs. 10 and 11)**.

In EVT, a retrograde puncture of the distal artery is often used to create a bidirectional approach from the distal and proximal sides **(Fig. 12)**. Trace MAP is also an extremely useful tool in these situations.

Even simpler than Trace MAP is the Sketch function. Sketch allows the operator to draw guidelines manually on fluoroscopic images with the mouse in the control room or the joystick in the examination room. Although Sketch is much simpler than Trace MAP, its simplicity also makes it convenient and easy to use and a valuable tool in stent positioning.

I will use either Trace MAP or Sketch for procedures depending on the situation.

Fig.8 Trace MAP-guided wire manipulation for CTO from SFA origin

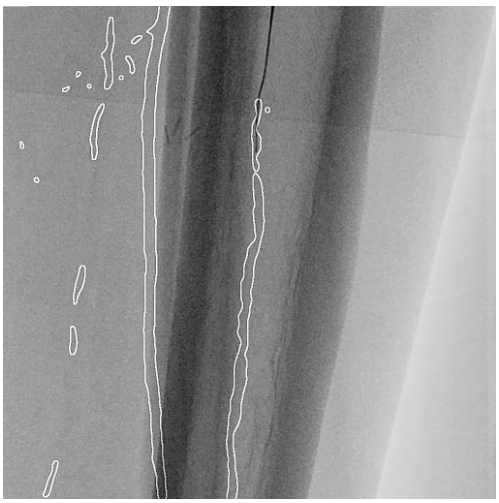

Fig.9 Trace MAP-guided wire manipulation for below-knee arterial lesion

Fig.10 Trace MAP-guided stent placement at iliac arterial bifurcation

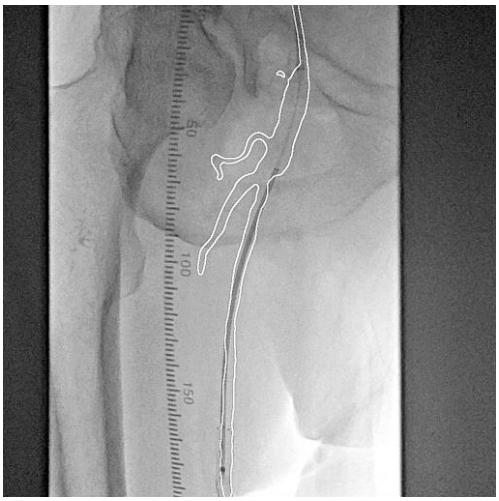

Fig.11 Trace MAP-guided stent placement at SFA origin

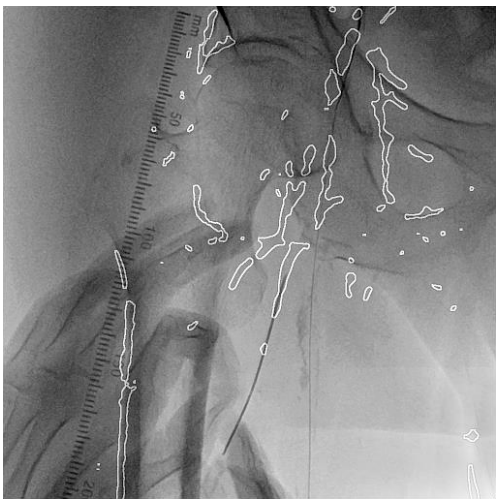

Fig.12 Trace MAP-guided distal puncture of deep femoral artery

3. Summary

In this article, I list the greatest features of Trinias, an angiography system of which I am entirely enamored.

The westernization of dietary habits is increasing the numbers of patients with lifestyle diseases, and PAD may be considered a national disease in Japan, particularly since the number of Japanese people on maintenance dialysis is so high. EVT techniques and devices are constantly evolving, and procedure outcomes are improving dramatically both in the short and long term. As a result, peripheral artery specialists and many other interventionists will encounter EVT with increasing regularity in the coming years, and reducing the invasiveness of EVT for patients and the stress of EVT for operators will become important topics of interest. On that note, Trinias is my favorite angiography system and I love everything about it.

Reference

1) Hayakawa, et al. Heart and Vessels, 15 Apr 2019, 34(11): 1740-1747

RAD

Experience Using RADspeed Pro after Adding POWER GLIDE

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Yoshiyuki Ioka

1. Hospital Introduction

Japanese Red Cross Aichi Medical Center Nagoya Daini Hospital (formerly Japanese Red Cross Nagoya Daini Hospital) **(Fig. 1)** is a foundation hospital in the eastern part of Nagoya City. The hospital is equipped with advanced medical equipment and the latest facilities and was the first hospital in Aichi Prefecture to be approved as a regional medical care support hospital. The hospital provides regional medical care as a critical care center, general perinatal care center, disaster base hospital, and designated regional cancer care hospital, and is also accredited by Joint Commission International (JCI), an international organization that evaluates the quality of medical care and patient safety.

The hospital also goes by the name “Yagoto Nisseki,” taken from the name of the local area, and the nearby subway station is also called “Yagoto Nisseki Station.” The hospital has 806 beds (804 general beds and 2 beds for class 1 infectious diseases) and 1,859 members of staff (as of June 1, 2021), with 41 radiological technologists on staff including 30 men and 11 women.

The general radiography examination room is located in the Diagnostic Imaging Center **(Fig. 2)** on the first basement floor of ward 3, where one dedicated chest radiography system and four general radiography systems are in operation. General radiography is a crucial examination used to prepare radiographs of various parts of the body, such as the chest, abdomen, and every bone in the body. The importance of general radiography is shown by the approx. 10,000 examinations performed in April 2021 alone.

Fig.2 Diagnostic Imaging Center Reception

2. Background to Acquisition of RADspeed Pro

In May 2019, one of our four general radiography systems was replaced due to aging equipment. Shimadzu’s RADspeed Pro was selected based on the following primary requirements: (1) able to perform long view radiography with ease, (2) X-ray tube support can be controlled with ease, (3) substantial improvement in patient imaging

Fig.1 External View of Japanese Red Cross Aichi Medical Center Nagoya Daini Hospital (formerly Japanese Red Cross Nagoya Daini Hospital)

throughput. As well as the ability to perform tomosynthesis and long view radiography with ease, RADspeed Pro comes equipped with convenient functions such as an automatic system tracking function and auto-positioning function for imaging. However, due to the multifunctional design of the X-ray tube support control unit and collimator unit, the equipment is heavy, weighing approx. 300 kg. As a result, we have had concerns about the large physical strain on operators when manually operating the X-ray tube support. Therefore, when the general radiography systems were updated in February 2021, we added the “POWER GLIDE” power assist function to our existing RADspeed Pro system to reduce the physical strain on operators when manually operating the X-ray tube support.

3. Outline of Existing System

3.1 X-Ray Tube Support Control Unit

The X-ray tube support control unit has a liquid crystal display (touch panel) that displays the patient’s name and SID, and can also be used to adjust radiographic conditions and irradiation field size (Fig. 3). The X-ray tube support has a vertical travel range of 1,600 mm and can be rotated freely and fixed at any angle on the vertical axis.

Fig.3 LCD Screen
The LCD screen can be used to check the patient’s name and adjust radiographic conditions and irradiation field size.

3.2 Long View Radiography

After setting a Start Position and End Position, the operator simply presses the set button and the system automatically adjusts the X-ray tube angle and image receptor (FPD) in the Bucky stand to their imaging positions in preparation for radiography. If two acquisitions are needed, the total acquisition time is about 5 seconds. The number of acquisitions is determined automatically based on the size of the target area. For standing radiography, the Bucky stand image receptor is moved up and down automatically following the changing angle of the X-ray tube. Because of this movement, a fender wall must also be installed for safety reasons (Fig. 4). The fender wall has hand grips on both sides and a belt that restrains the trunk of the patient. The position of the hand grips can also be adjusted vertically and rotated. Our hospital’s own measuring rulers has also been fixed in place on the acrylic board of the fender wall. There are two pins on the bottom at the front of the fender wall on either side that lock the fender wall in place once moved into a specific position. This lock can be released by moving the fender wall while depressing either one of the pins.

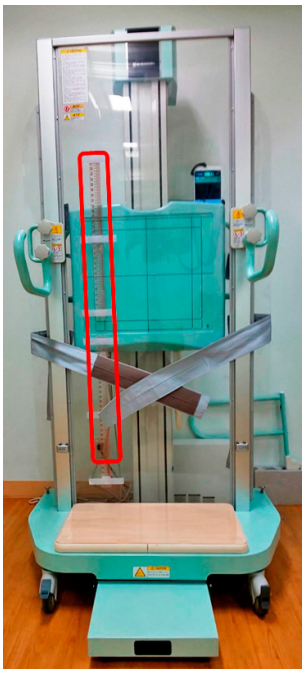

Fig.4 Fender Wall for Long View Radiography With a Fixed Measuring Ruler. Hand Grips on both Sides and Belt for Trunk Restraint

3.3 Automatic System Tracking Function

The X-ray tube support follows the vertical movement of the image receptor of the Bucky stand or Bucky table. It tracks movement when the X-ray tube is in a specific position longitudinally and transversally. The image receptor in the Bucky table also tracks the swing angle of the X-ray tube (Fig. 5).

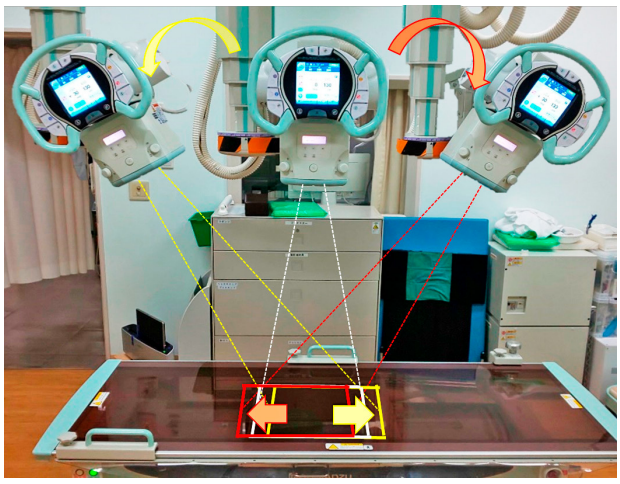

Fig.5 Automatic System Tracking Function
Image receptor tracks the X-ray tube swing angle.

3.4 Auto-Positioning Function

The auto-positioning function automatically moves the X-ray tube support to a position preset in the generator program at the touch of a button on the remote control. Frequently used imaging positions can also be stored in the remote control (up to four positions).

4. Overview of Added Functions: POWER GLIDE and Singe-Axis Move Buttons

4.1 POWER GLIDE

POWER GLIDE, which uses GLIDE Technologies, assists system operation by quickly detecting forces applied to the X-ray tube support handle by the operator, calculating the necessary power assistance, then driving three motors in the longitudinal, transverse and vertical directions. The level of power assistance provided by POWER GLIDE can be switched between three levels via touch panel controls on the X-ray tube support LCD screen (Fig. 6). Operators can select the optimum power assist level for a given control scenario, such as High for large movements when repositioning the X-ray tube support between standing and supine radiography, or Low for less power assistance and more precise positioning. Acceleration (Acc), deceleration (Dec), and maximum speed (Speed) can also be adjusted along each axis of motion from the Power Assist Setting Menu (Fig. 7), allowing power assist levels to be customized to the preferences of the facility.

GLIDE Technologies is comprised of five component technologies: sensing technology, torque control technology, shock reduction technology, stability control technology, and balance technology.

(1) Sensing Technology

The handle instantly detects force applied along three axes (longitudinally, transversally, and vertically) even while the handle is rotated vertically or horizontally. This allows the X-ray tube support to be controlled by the exact same method as conventional systems.

(2) Torque Control Technology

Eliminates unnaturalness during movement by compensating for the characteristics of the motor and system and always transmitting accurate torque without delay.

(3) Shock Reduction Technology

Reduces sudden jerks in movement by the system, such as when the operator inadvertently applies a strong force on the control handle.

(4) Stability Control Technology

Enables control over the direction of the system by detecting force applied by the operator in multiple directions.

(5) Balance Technology

Enables smooth operation by absorbing the elastic force in the spring arising from vertical movement by the X-ray tube support.

4.2 Single-Axis Movement Buttons (Fig. 8)

This feature moves the X-ray tube at a constant speed in a predetermined direction, such as transversally, when a single-axis movement button is depressed.

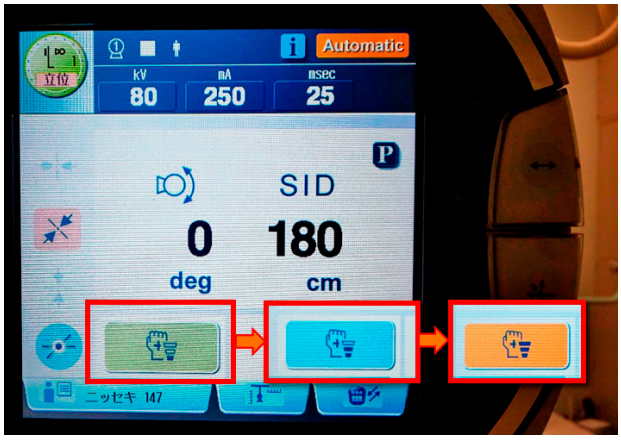

Fig.6 LCD Screen: Changing the Power Assist Level

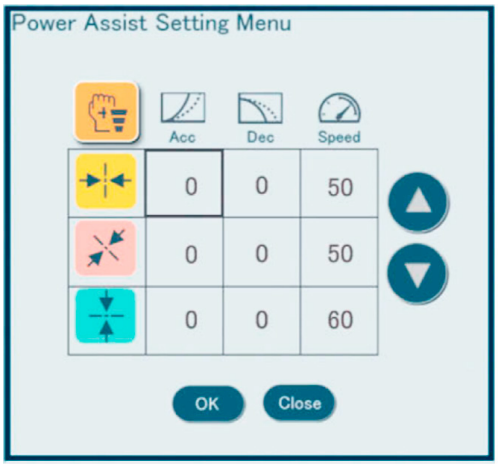

Fig.7 Power Assist Setting Menu
Acceleration, deceleration, and optimum speed can be adjusted along each axis of motion.

Fig.8 Single-Axis Movement Buttons

5. Experience Using the Existing RADspeed Pro System

5.1 X-Ray Tube Support Control Unit

Displaying patient names on the LCD screen has made patient verification easier and reduced patient misidentification. Displaying the SID on the screen has also freed operators from the time-consuming task of using measuring tape mounted on the collimator to measure SID. The size of the irradiation field can be switched with ease from the LCD screen. The X-ray tube support has a wide range of movement range that makes radiography safer by removing the need for patients to stand on a platform when imaging areas nearer the floor, such as during pediatric radiography or standing radiography of the knee. The X-ray tube support can also be fixed at any angle around the vertical axis, making positioning for axial projections of the shoulder easy.

5.2 Long View Radiography

Although the fender wall takes time to install, the trunk restraining belt and hand grips are secure and allow for safe radiography of patients with disabilities. Our hospital's own measuring ruler has also been attached to the fender wall, which eliminates any concerns about forgetting to attach a ruler. However, because the fender wall stands 20 cm above the floor (two 10-cm steps), caution is needed when patients step on and off the stand. When radiography includes multiple acquisitions, caution is also needed to avoid positional misalignments during image synthesis caused by poor breath-holding or patient movement. The fender wall is held securely in place by its pins, but in the rare instance either of the pins is released, a warning is displayed on the X-ray tube support LCD screen. Knowing that safety measures are in place to prevent radiography from proceeding should a pin be released provides peace of mind.

5.3 Automatic System Tracking Function

The X-ray tube support follows the vertical movement of the Bucky stand image receptor. This feature has eliminated examination delays caused by smaller operators physically unable to reach the X-ray tube support control unit. This feature also shortens positioning times for operators who work alone, as the operator no longer needs to move both the X-ray tube support and image receptor. In addition, the X-ray tube support follows the vertical movement of the Bucky table to maintain a constant SID, eliminating the need to continuously measure SID based on the height of the Bucky table. Because the FPD in the Bucky table also tracks the swing angle of the X-ray tube, there is less need to worry about missing the irradiation field when radiography is performed at an angle, such as during pelvic inlet and outlet radiography.

5.4 Auto-Positioning Function

Using the auto-positioning function via a remote control allows the operator a better overall view when controlling the X-ray tube support, enabling easy visual confirmation of the patient, medical personnel, and potential obstacles for safer positioning. The topmost button on the remote control (Fig. 9) is linked to a position preset in the generator program, which helps to prevent SID errors and positioning errors during radiography. Even if there is no preset position linked in the generator program, frequently used positions stored in designated locations on the remote control are

Fig.9 Auto-Positioning Remote Control
a) Linked to a preset position in the generator program
b) Standing SID 180 cm
c) Supine
d) Lateral (side view)
e) Patella axial view (retract position)

available. At our hospital, the remote control has the following positions stored in order from top to bottom: standing SID 180 cm, supine, lateral (side view), patella axial view. Having these positions stored via the remote control has been extremely useful. At our hospital, one remote control is kept on the wall near the control console and another is kept near the Bucky stand. The back of each remote control is magnetized, so they can be carried and operated within the hand or while attached to a support column or another structure. This feature has reduced the distance covered by the operator and physical burden of positioning.

6. Experience Using the Added Functions: POWER GLIDE and Singe-Axis Movement Buttons

6.1 POWER GLIDE

Auto-positioning alone does not yet provide the flexibility the X-ray tube support needs to handle a wide variety of radiography sites and positions. For this reason, the X-ray tube support must often be operated manually. The newly added POWER GLIDE provides smooth movement from beginning to end when manually operating the X-ray tube support and does not result in unnatural movements that can be stressful for the operator. Although there was a learning curve when adjusting to POWER GLIDE, it did not take long to become familiar with the new feature. Operators can select from three power assist levels on the X-ray tube support LCD screen to suit their preference, and POWER GLIDE has received a number of favorable comments including that even physically weaker operators can now operate the X-ray tube support one-handed with ease. POWER GLIDE also automatically reduces the power assistance to its lowest level when the exposure field lamp is turned on, a feature that helps with more precise positioning.

6.2 Single-Axis Movement Buttons

When radiography is being performed by multiple operators, an operator behind the X-ray tube support can hand the X-ray tube support over to an operator in front of the system by simply pressing a single-axis movement button. This has reduced the physical strain on operators who no longer need to place themselves in awkward positions to hand the X-ray tube support over to another operator.

7. Summary

The RADspeed Pro general radiography system not only improves the efficiency of radiography work, it also offers excellent convenience and safety. POWER GLIDE, which was added to our RADspeed Pro system, is an evolution of the power assist function we are familiar with seeing in portable (mobile) radiography systems and provides smooth and natural movement. POWER GLIDE not only reduces the physical strain on the operator when manually operating the X-ray tube support, it also helps improve patient throughput. POWER GLIDE comes with three power assist levels and conveniently drops its power assistance to the lowest level when the exposure field lamp is turned on. One area of concern in terms of safety is the potential for accidents arising from contact between the X-ray tube support and a patient, medical personnel, or operator since the X-ray tube support is often under automatic control by the auto-positioning function or automatic system tracking function. Therefore, we would like to see the X-ray tube support equipped with sensors or other safety measures that stop the X-ray tube support just before contact or when contact is detected.

RAD

Introducing Tomosynthesis to our Hospital —From the Perspective of a Radiological Technologist—

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Hidehiko Fukuoka

1. Hospital Introduction

Kariya Toyota General Hospital is a private medical institution located in Kariya City, Aichi Prefecture, that is operated by Toyota-Kai Medical Corporation (consisting of Kariya City, Takahama City, and 8 Toyota Group companies). The hospital is at the center of its 10-km radius medical catchment area and is responsible for providing medical care to around 700,000 people. The hospital has 704 beds, is certified as a critical and emergency care center, and handles all emergency cases from primary to tertiary level under the slogan “emergency care with an open door” 24 hours a day, 365 days a year.

2. Introducing and Operating Tomosynthesis

2.1 Introducing Tomosynthesis to our Hospital

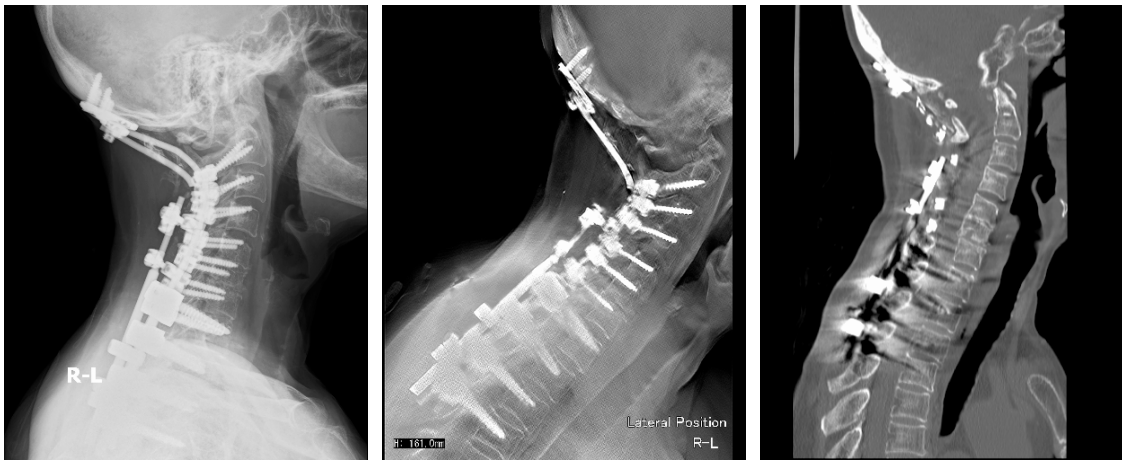
The general concept behind radiological examinations at Kariya Toyota General Hospital is that inpatient and outpatient examination rooms are operated separately out of concern for patient psychological wellbeing. In March 2020, a RADspeed Pro EDGE system was installed in the outpatient examination room area adjacent to the emergency room to replace aging equipment. In recent years, specialized examinations such as X-ray CT and MRI have come into widespread clinical use, and loss of staff interest in general radiography has been an issue for the radiology department. As a result, the decision was made to introduce tomosynthesis to the hospital to act as a “priming charge” in the field of general radiography.

To prepare for tomosynthesis at the hospital, briefing sessions on tomosynthesis were initially held for orthopedic surgeons, and brochures were prepared that explained tomosynthesis to patients. Since the hospital had no experience with tomosynthesis, orthopedic surgeons were told about the reduced X-ray dose levels to patients and the advantages of tomosynthesis compared to radiography and X-ray CT examinations. We also decided a certain number of cases and an exchange of views on images from those cases was needed to establish tomosynthesis at our hospital. First, a list of patients who had undergone total knee arthroplasty (TKA) and total hip arthroplasty (THA) was created each month, and cases were selected alongside the attending physician for whom tomosynthesis offered potential benefits. The brochure explaining tomosynthesis to patients was used to describe the benefits of tomosynthesis and the cost of the examination, and patients who provided assent underwent tomosynthesis.

2.2 Operating Tomosynthesis at our Hospital

As previously reported in this journal, tomosynthesis requires special imaging skills to obtain good quality images, such as positioning that takes the X-ray tube travel direction into consideration and firm restraint of patient movement. When tomosynthesis was first introduced and not well known at our hospital, physicians requested tomosynthesis in order to appraise the technology, hence reliable image quality was essential. To achieve this, during the initial stages of introducing tomosynthesis, on-the-job training was provided to around 10 members of staff with considerable experience in the general radiography section. After working on 3 to 5 general cases, staff members were able to perform tomosynthesis and subsequent image reconstruction unaided. However, cases with geometrically complex implants, such as the postoperative cases shown in **Fig. 1**, require special skills. Help from the manufacturer’s application specialist was sometimes requested to discuss examinations beforehand and watch the examination remotely.

Table 1 shows the number of tomosynthesis examinations performed in FY 2020 at our hospital. Tomosynthesis was most commonly requested



a) Radiograph b) Tomosynthesis image c) X-ray CT image

Fig.1 Posterior Occipito-Thoracic Fixation

Table 1 Tomosynthesis Examinations Performed at our Hospital (FY 2020)

Purpose of Request	Number of Cases	Percentage
TKA	62	39%
THA	50	31%
Post spondylodesis	27	17%
Assessment of hand bone union	5	3%
Assessment of insufficiency fracture bone union	4	2%
Spondylolysis	3	2%
Rheumatism examination	3	2%
Trauma examination	3	2%
Sacroiliitis examination	2	1%
Laminoplasty	1	1%
Post foraminotomy	1	1%
Total	**161**	

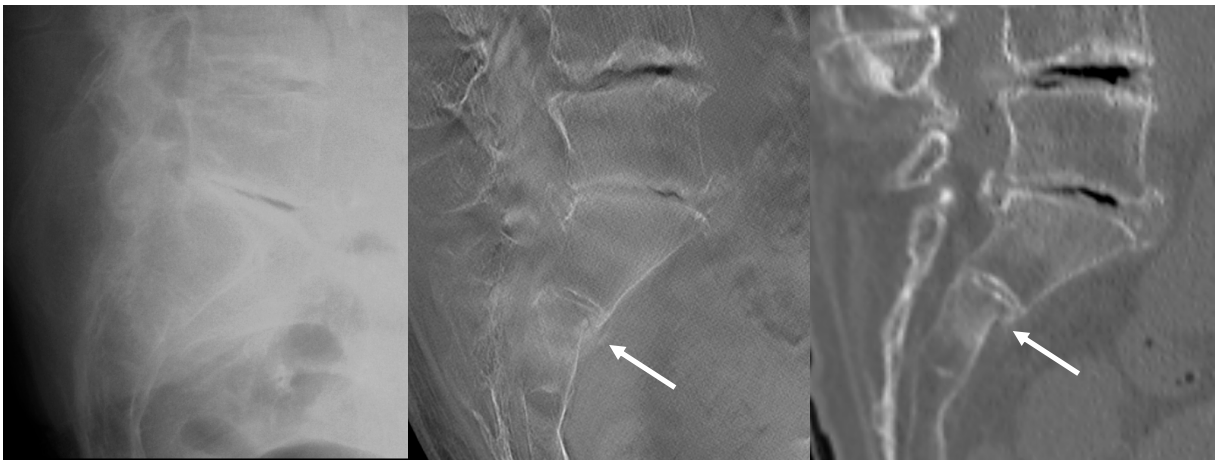
for TKA, followed by THA and post-spondylodesis. Because tomosynthesis produces fewer metal artifacts compared to X-ray CT and creates tomographic images with good in-plane resolution characteristics, we found it very useful in postoperative cases and the modality was highly rated by orthopedic surgeons.

A mini-conference with the requesting physician is also always held after an examination. This conference must be held promptly, and is used to exchange opinions on tomosynthesis image findings, image quality, and positioning, and implement improvements for subsequent examinations. Raw data (projected images) from tomosynthesis is also stored on the PACS server for use in medical treatment based on a request made by physicians in the mini-conference. Raw data can be evaluated in the form of a radiograph at any angle along the path of X-ray tube travel within the range of the set X-ray tube swing angle. Raw data is used to differentiate artifacts from other structures and to obtain information additional to that found in the radiographs. However, users are currently limited in the image processing parameters they can configure and apply to this raw data and image quality is inadequate. We hope this feature will be improved in the future.

2.3 Secondary Benefits of Introducing Tomosynthesis

Tomosynthesis was introduced to our hospital with the expectation it would act as a “priming charge” in the field of general radiography. Relatively large-scale medical institutions such as ours tend to provide fewer opportunities for face-to-face contact with physicians, but as described in the previous section, tomosynthesis has overwhelmingly increased opportunities for communication with the requesting physician. This communication is extremely useful and provides a lot of useful information about the needs of physicians not only related to tomosynthesis but also other modalities, and information about fields other than diagnostic imaging such as diagnostics and therapeutics.

Tomosynthesis has also increased discussion between radiological technologists. Tomosynthesis has reminded us of the importance of radiographic techniques such as correct positioning and firm restraint of patient movement. While tomographic image reconstruction allows the tomographic plane to be tilted up to 20 degrees in any position in the XY direction, good quality images require good projection data, which means good positioning. Less experienced staff say their radiographs have improved since they started working with tomosynthesis and their understanding of image anatomy has improved because tomosynthesis provides more opportunities to view tomographic images. We believe a secondary effect of introducing



a) Radiograph at initial examination b) Tomosynthesis image after 2 weeks c) X-ray CT image after 2 weeks

Fig.2 Sacral Insufficiency Fracture

tomosynthesis has been to improve awareness in the field of general radiography and improve radiographic techniques.

3. Clinical Cases

Three cases of tomosynthesis performed at our hospital are presented.

3.1 Sacral Insufficiency Fracture

A woman in her 80s visited the emergency room with a chief complaint of low back pain and no obvious episode of trauma. A radiograph from an initial examination showed no clear imaging evidence of the chief complaint (Fig. 2 (a)) and the patient was sent home for therapeutic rest. When symptoms did not subside after 2 weeks, the patient visited our department of orthopedic surgery. Upon performing tomosynthesis, a clear fracture line was discovered in the second sacral vertebra along with a high absorption area suggestive of bone fusion on the anterior side (Fig. 2 (b)) and the patient was diagnosed with a sacral insufficiency fracture. An X-ray CT image taken at the same time (Fig. 2 (c)) revealed a discontinuous bone cortex, but tomosynthesis was able to visualize these findings more clearly due to its superior in-plane resolution characteristics. Tomosynthesis also uses a lower tube voltage than X-ray CT, which may be better for capturing the continuity of trabecular bone. A search of the literature on sacral insufficiency fractures found reports noting the difficultly of identifying fractures by radiography and the benefits of X-ray CT and MRI[1, 2], but this case points to the usefulness of tomosynthesis in identifying sacral insufficiency fractures.

3.2 Rheumatoid Arthritis

A woman in her 60s had received treatment for rheumatoid arthritis for the last 20 years and continuously undergone radiography of the hands and feet. A dislocation of the right third metatarsophalangeal joint was found, but bone breakdown could not be adequately discerned due to the metatarsal bone and proximal phalange overlapping on the radiograph (Fig. 3 (a)). Meanwhile, tomosynthesis allows observation of any transverse plane and was used to observe the metatarsal bone and proximal phalange separately in detail (Fig. 3 (b)).

Early bone erosion is a prognostic factor for poor outcomes and is important for deciding the treatment strategy for rheumatoid arthritis. Although bone breakdown is advanced in the present case, in cases where bone breakdown is at a relatively early stage, plain radiography is considered useful for making changes to medication and otherwise identifying timings for therapeutic intervention. The orthopedic surgeons at our hospital strongly believe that tomosynthesis may be capable of capturing findings of bone breakdown directly linked to treatment with greater sensitivity than plain radiography, and an investigation of this topic is currently underway.

3.3 Hip Arthroplasty

A woman in her 70s underwent hip arthroplasty for right hip osteoarthritis. A POLARSTEM (Smith & Nephew) fully HA-coated cementless stem was used. Radiographs and tomosynthesis images obtained during follow-up 2 weeks and 3 months after surgery are presented (Fig. 4). Spot welds (SW), which are linear shadows indicative of bone formation, could not be identified in the radiograph at 3 months after surgery (Fig. 4 (b)). By contrast,

a) Radiograph b) Tomosynthesis image

Fig.3 Rheumatoid Arthritis

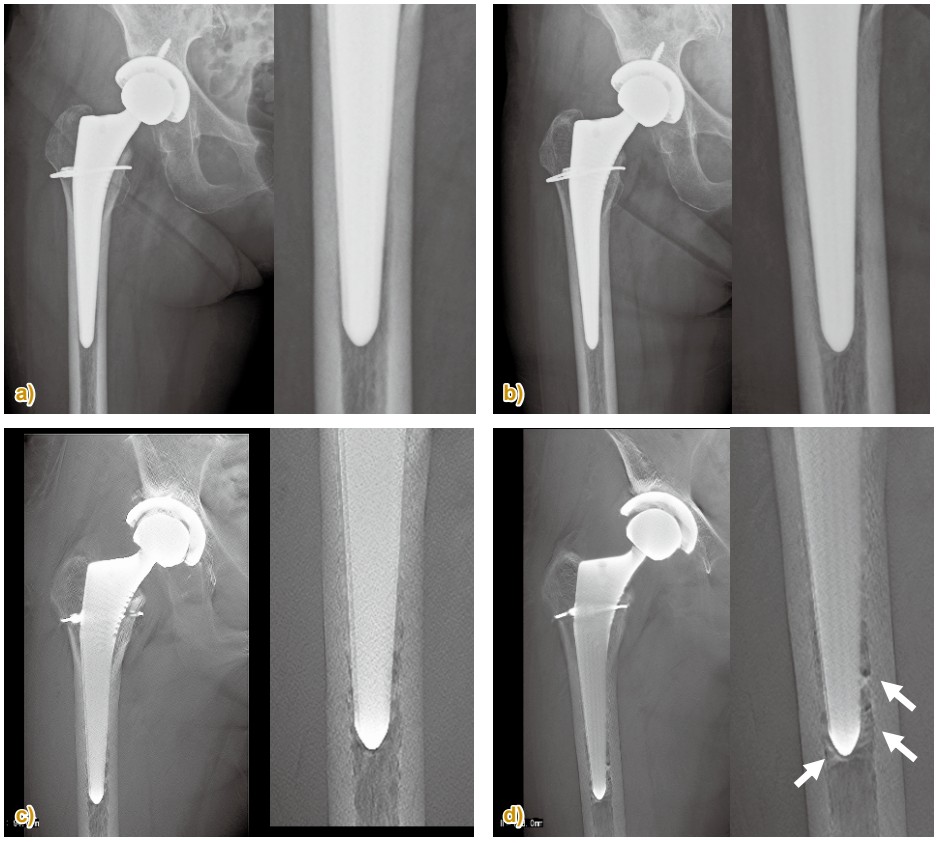


Fig.4 Hip Arthroplasty
a) Radiograph 2 weeks after surgery b) Radiograph 3 months after surgery
c) Tomosynthesis image 2 weeks after surgery d) Tomosynthesis image 3 months after surgery

SWs are clearly visualized by tomosynthesis in zones 4 and 5 at 3 months after surgery (Fig. 4 (d)). Biological fixation is important for favorable long-term outcomes, and this case demonstrates that biological fixation can be assessed earlier by tomosynthesis than plain radiography.

4. Future Prospects

As described in this article, tomosynthesis is currently used at our hospital primarily for postoperative cases in the field of orthopedic surgery, but we would like to expand its use to emergency room cases. Residents are often responsible for the majority of initial medical care provided in emergency room cases, and diagnostic imaging services outside

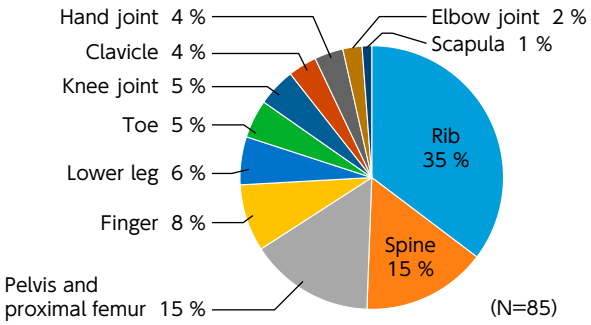


Fig.5 Fracture Sites Not Identified in Imaging Findings by Radiological Technologist in Out-of-Hours Emergency Examination (FY 2020)

of consultation hours at our hospital, such as at night or on holidays, appear to be unsatisfactory when compared to consultation hours. Therefore, radiological technologists provide medical support by helping to interpret radiographic images and reporting to the requesting physician upon encountering critical radiological findings. However, even our department frequently uses less experienced staff for out-of-hours care and critical finding reporting may sometimes be inadequate. **Fig. 5** shows the results by fracture site from an analysis of cases where fracture findings were not identified by the radiological technologist in emergency out-of-hours examinations in FY 2020. The most common site is the ribs (35 %), followed by the spine (15 %) and the pelvis and proximal femur (15 %). Based on this, we want to utilize the strengths of the RADspeed Pro EDGE, which can perform both radiography and tomosynthesis with ease, to strengthen medical support for emergency cases by using tomosynthesis when radiographs do not provide clear findings.

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Stories of Kyoto-born Masterpieces — ㉕

Numerous outstanding products have helped shape the history of Kyoto — here we outline the stories hidden behind them.

The most popular glass pen is the Seifu. With a thick, heavy grip, the pen requires little downward pressure and is easy to write with. From above, the three fresh colors shown here are named Seseragi, Sakura, and Wakaba.

Glass Pens

Glass pens are a work of art, with detailed wave-like patterns applied to the gently colored, see-through glass. These glass pens are one type of dip pen, which require the nib to be dipped in ink prior to use.

The patterns on the end of the nibs of these glass pens are not simple designs, but grooves that allow ink to pass through. When once dipped into ink, capillary action draws enough ink into these grooves to write on a single postcard. Unlike fountain pens, glass pens do not need to be used in certain directions, and their smooth, fluent feel along the writing surface is perhaps their most outstanding feature.

Glass pens are thought to have been first developed in Japan, and their history can be traced back to the Meiji period. At the time, many pens had glass nibs, but used different materials, such as bamboo, for the body. It was also common to use plastic, which was similar in appearance to glass. While they were useful on the one hand, they were also prone to wear and damage, and so practicality was undeniably a sticking point. One solution was to use hard glass.

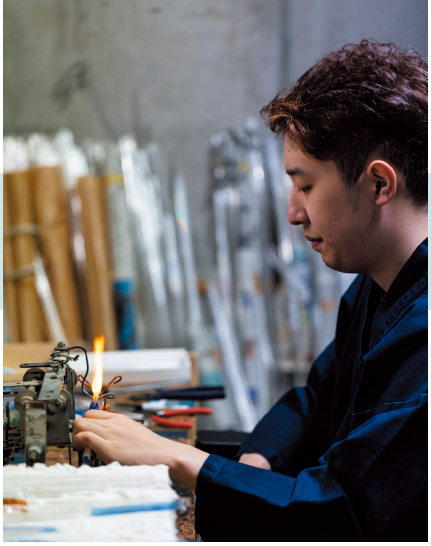
Entirely Unique, Hard Glass Pens

Hard glass is often used in physics and chemistry equipment, such as test tubes and beakers. While the material is difficult to break and boasts excellent heat and wear resistance, it can be difficult to work. The hard glass used in glass pens takes the form of a glass rod, just one centimeter in diameter, with a carefully balanced blend of silica sand and other materials. This blend ratio differs by workshop.

Integrated glass pens are made by connecting two different glass rods, one for the body and one for the nib. Although work begins on the body before moving onto the nib, another glass rod is attached to the opposite side to enable work on the body. As the glass is worked over a 1,200°C flame and cannot be held directly, this glass rod on the opposite side acts as a handle. After joining the handle, the glass rod for the nib is attached to the other side. After joining all three rods into one, the next step is to apply the pattern to the body.

The patterns are created by rotating and twisting the glass over the flame. The thinner the flame the more detailed the pattern, but

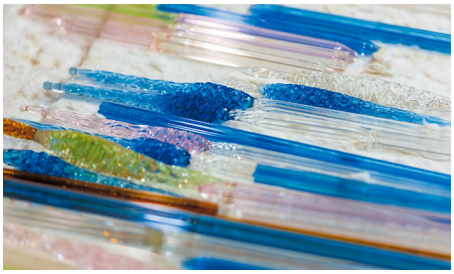
Creating the body for the Miyabi model. The blue body is held in the right hand while rotating it in a fixed direction to apply the pattern. The wave-like pattern on the thick part is made by lightly pushing on the rod.



As the craftsman uses his bare hands to turn the glass, in the winter, when hands tend to become dry, the work is made even more challenging.

The glass rods are cut into the required length using a special cutting machine in the workshop.

Work on the nib requires the most precision. Too much oxygen can cause the flame to become too strong and destroy the nib.



After the work is complete, the hard glass is placed on a towel where it takes 15 minutes to cool down.

The limited-edition 93-Nagare, with beautiful flowing lines, was created by Kan Seifu at the age of 93. Brown glass is said to be the most difficult to work with, yet exudes elegance.

as it's difficult to work the glass over too thin a flame, the width of the flame must be perfect. This can only be made possible using a premix gas burner, through which the thickness of the flame is determined by adjusting the balance of gas, air, and oxygen.

Once the body is complete, work moves onto the nib. Processing the nib is difficult: If the nib is on the same central axis as the body, the ink can successfully be drawn up into the pen; if the body and nib are out of line, however, the ink can drip out. While making sure the axis is in line, the nib is rotated and pulled over the flame, and slowly but carefully stretched out. It is said that, as the process puts such a strain on the craftsman's eyes, it can only be carried out two hours after he wakes up, which is when his eyes are in peak condition. The craftsman uses neither a magnifying glass nor gloves, only relying on the sensation in his fingers, his eyes, and his experience.

Inheriting Skill and Spirit

It was the previous-generation head of Glass Pen Workshop HoNoO, Kan Seifu, who first created these hard integrated glass pens. He first came up with the product in his 70s, and today it is his grandson and second-generation head, Kan Seiryu, who carries on the trade. Although to begin with the pens were only made as gifts, they proved incredibly popular and came to be sold in their own right. Today they are lovingly used by famous film directors, artists, doctors, and architects. "They can be cleaned easily by simply dipping them in water and giving them a shake. Further, users can be sure that the nibs will never break through regular use," says Seiryu. This confidence can be seen in the offer of a lifetime guarantee, which includes free-of-charge repairs for any wear or damage, at any time. "Although appearance is important, writing performance is even more so. Without their smooth feel, hard glass pens would be nothing." The artisan spirit of Kan Seifu has been firmly passed down to the second generation.

Special thanks to: Glass Pen Workshop HoNoO;
https://www.kanseifu.com/
https://shop.kanseifu.com/

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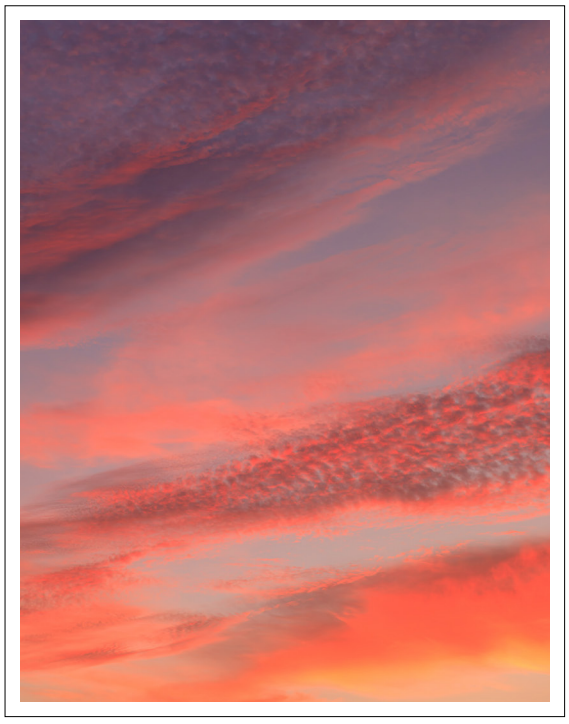

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