RAD

Experiences Using the RADspeed Pro EDGE Package

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1. Hospital Description

Our hospital was originally established in Tsukuda in 1958, near Chibune Station on the current Hanshin Main Line, as Chibune Clinic. As an acute care general hospital for the Nishiyodogawa Ward of Osaka City, the hospital serves an important role in providing healthcare for the region and also for providing perinatal, maternal, and child healthcare. On July 1, 2017, our newly updated hospital was opened at a new location in front of the Fuku Station on the Hanshin Namba Line **(Fig. 1 and 2)**.

Fig.1 Exterior **(a)** of and View **(b)** from the Hospital

Fig.2 Hospital Front Desk

Built based on the concept of “Safety and Security for the Future,” the earthquake-proof building designed to withstand natural disasters has nine floors with approximately 32,700 m^2 of floor area. Though the number of beds remains the same (292 beds), it is 2.5 times more spacious than the previous facility, so that patients can be provided with a more restful space. As before, the new Chibune General Hospital will continue to serve as an acute care general hospital for treating key diseases, such as diabetes, myocardial infarctions, strokes, and cancer, for providing adult healthcare involving the cardiovascular system, gastrointestinal system, kidney dialysis, cerebrovascular system, or gynecology, and for improving perinatal care. In addition, the hospital is actively involved in emergency care for foreign patients, thereby providing sophisticated healthcare that is safe and worry-free for a wide variety of Japanese and foreign patients.

The recent update involved replacing almost all of our diagnostic imaging systems. As part of that process, we introduced three new Shimadzu X-ray systems, including the RADspeed Pro EDGE package. The follow is a report of our experience with starting up the systems, starting clinical operations, and using tomosynthesis.

2. Background of Adoption

In terms of criteria for selecting a general radiography system for the relocated hospital, we needed to start the selection process with a blank sheet of paper, regardless of the manufacturer. As a result, the department personnel at the time prepared the following wish list.

- Ability to perform axial projection radiography of hip joints on both sides without having to reposition the patient

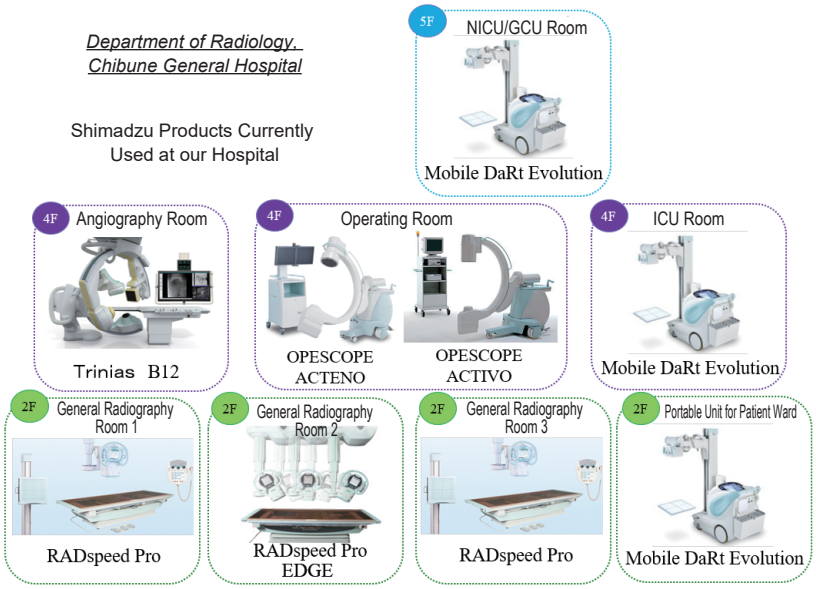


Fig.3 Shimadzu Products Currently Used at the Hospital

- Ability to fix the X-ray tube at any angle to accommodate a variety of radiography situations
- Ability to perform long view radiography easily and stitch images automatically
- Include a light-weight FPD with simple and user-friendly image processing operability.
- Include a wide variety of image processing functions, including a virtual grid function.

First, at the construction design stage, we decided to include three general radiography rooms, all capable of general radiography in standing and supine positions. The radiography room interiors were designed with enough space for flow line of the patient and technologist, for acquiring images either in a wheelchair or on the bed, and so on.

Since the general radiography systems would be used by all department personnel, the selection process was discussed many times. Based on experience using X-ray generators, an overwhelming majority recommended Shimadzu general radiography systems, due to easy operability and attention to detail. Other key reasons given included useful functionality, such as interlocking functions around the components, long view radiography, and auto-positioning, and the sincere and prompt services they provide. In terms of image processing, reasons included our expertise using Fujifilm's CR system, which was the first system to successfully offer digital X-ray imaging, extensive image processing technology, such as grid line elimination, multi-frequency processing, and noise suppression, the light weight design, with a 2.6 kg (at the time) 14 × 17-inch size FPD, while also providing a 310 kg load capacity. Consequently, we decided to introduce Shimadzu RADspeed Pro EDGE package which is a general radiography systems in combination with Fujifilm FPD Digital Radiography system **(Fig. 3 and 4)**.

Fig.4 Layout of General Radiography Room 2

3. Cooperation between the RIS Terminal and the Image Processing System

For radiography orders input from electronic medical records in the HIS terminal (Fujitsu), the patient information and radiography request information is obtained from the RIS terminal (Fujitsu) via the modality worklist management (MWM) service and smoothly transferred to the X-ray high voltage generator (UD150B-40) via the Digital Radiography system (Fujifilm). Images with adjusted brightness and contrast are checked on the image inspection system terminal and then sent to the PACS system **(Fig. 5)**.

It automatically performs the "select the Anatomical Program," "select the X-ray exposure conditions," and "adjust the irradiation field size" steps, which were previously performed by technologists. That allows

Fig.5 Control Room
(Right to left: UD150B-40, the image processing unit, the tomosynthesis image processing unit, the electronic medical record terminal, and the image inspection system terminal)

the technologist to focus on assisting and positioning the patient, which, needless to say, significantly reduced the number of mistakes made selecting the Anatomical Program and X-ray exposure conditions.
However, in order to cooperate the entire process, from RIS terminal to image processing unit, an electronic medical records and RIS master database needed to be prepared before the system was introduced. That required specifying radiography parameters for the examination protocol for each target region, and required interlocking the RIS, image processing unit, and X-ray high voltage generator and verifying the link. Therefore, I want to express my gratitude to the technologists that entered and checked all those settings and say how happy everyone in the department is with how much easier the environment is to work in now.

4. Our Experience Using the Function for Interlocking the Ceiling-Mounted X-Ray Tube Support with the Digital Radiography system

After patient information is registered, then radiography study begins. The tube is automatically controlled by a wired remote controller **(Fig. 6)**. A technologist can operate it under watching the whole radiography room and confirming the patient position. If the switch is released during remote control operations, the tube movements stop immediately to ensure safety.
Also, a technologist can confirm the patient information at the LCD panel attached to the ceiling-mounted X-ray tube support. When the Bucky stand is raised or lowered during radiography based on patient height, the X-ray tube support also instantly moves accordingly.
The X-ray tube support also moves automatically when the Bucky table is raised to keep the appointed sauce -to-image distance (SID). When the Bucky table is lowered, the movement can be interlocked with the specified SID with a single press on the X-ray tube support switch. Maintaining a constant SID value previously involved measuring the distance with a tape measure, but now the SID can be easily confirmed on the LCD panel.
Hip joint images can be acquired from both sides without any difficulty due to a swivel rotation function of the X-ray tube support, which can be stopped at any angle and fixed securely.
There are also inconspicuous buttons hidden on the back side, near the bottom of the column. They include swivel rotation, all-free, and collimator lamp illumination buttons **(Fig. 7)**, which are very convenient for retracting the X-ray tube above a

Fig.6 Auto-Positioning

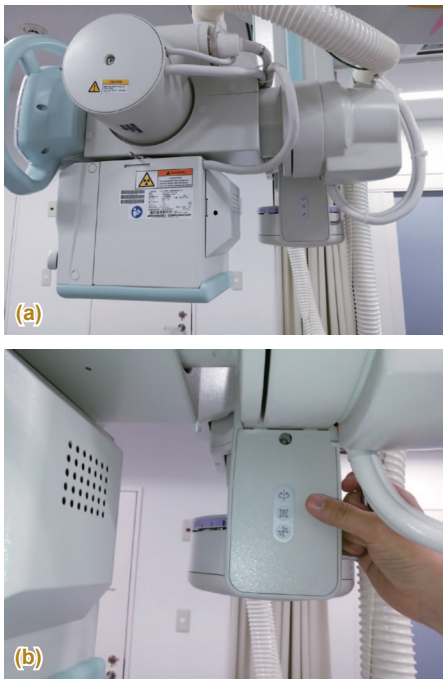


Fig.7 (a) X-Ray Tube Support
(b) Bottom of Support Column

gurney during an emergency, for example. We find this and other extensive functionality, which is not available from other brands, very useful.

5. Experience Using Long View Radiography

Previously, long view radiography involved mounting two or three 14 × 14-inch size imaging plates in a long CR cassette. After acquiring the images, the long cassette was replaced with a 14 × 14-inch cassette and load them to the reading equipment. Thus, it took about 10 minutes for each long view radiography. Furthermore, it was necessary to perform the post processing for three images and print them to the film, and to join the three sheets with adhesive tape. Not only did that require extremely tedious work by the radiological technologist involved, but if both lower extremities were acquired in two projections, then it would keep the radiography room occupied for long periods which was one of the things we wanted to improve the most.

After the new system was introduced, the fender wall for long view radiography looked very substantial, but was actually surprisingly light and moved smoothly, so it did not cause any problems in terms of taking up space in the radiography room **(Fig. 8)**. When placed in front of the Bucky stand, the fender wall can be fixed with two pin halls to prevent it moving when the patient steps up or down from it. If either pin is not engaged, a warning is displayed on the LCD panel attached to the X-ray tube support and radiography is disabled. Using a system designed with such consideration for patient and technologist safety is very reassuring. Large grip bars are provided on both sides to help patients step up/down from the fender wall easily. They are also very helpful for keeping proper posture.

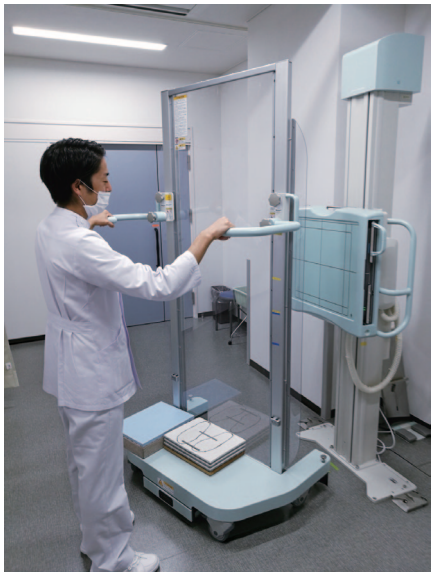


Fig.8 Fender Wall for Long View Radiography

Preparation for full-spine radiography can be completed by simply aligning the laser marker with the upper edge of the orbit for the starting point and between the legs for the end point and then pressing the set button, so that the tube and the image receptor on the Bucky stand are automatically moved to the radiography starting position. During the exposure switch is held to press, tube and image receptor movements are interlocked and radiography is finished within the approximately five seconds it takes to emit two or three exposures. Then to acquire a lateral view next, simply press the set button to immediately move the tube and image receptor to the same radiography starting point. Even long view radiography of the lower extremities can be performed more simply and quickly using almost the same procedure. A pre-view image of the full spine is displayed on the image processing monitor within about three to five seconds after exposure, so that examination results can be determined immediately. Density and contrast adjustment settings are usually already appropriate, if necessary the settings can be adjusted without taking time **(Fig. 9)**.

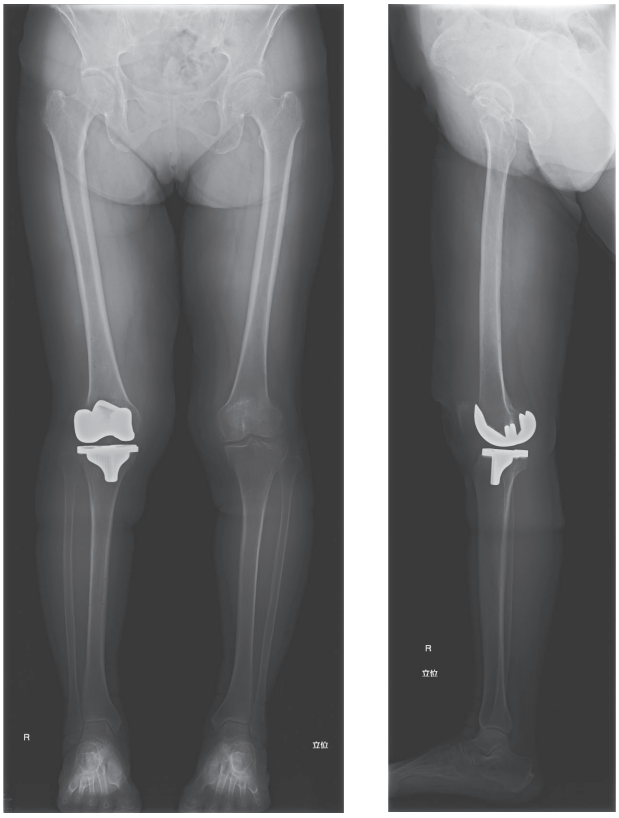
In our department, we have placed markings on the fender wall for long view radiography so that we can smoothly select the film size and number of exposures for long view radiography of the lower extremities without worrying about the settings **(Fig. 10)**.

When we were introducing the system, we worried that there might be problems at the seams where the images are stitched together or with body movement during the radiography, but there have been almost no such problems. Consequently, our overall impression based on efficiency and safety is that the long view radiography system is quite excellent.

6. Our Experience Using Tomosynthesis

Initially we were considering including tomosynthesis with a R/F system, but we put it hold on because of concerns that long wait times might occur during IVR examinations and that we would need to move a patient between radiography rooms and R/F room if we performed both radiography and tomosynthesis on the same day. That is exactly when we heard about the RADspeed Pro EDGE package, a general radiography system, capable of tomosynthesis.

The RADspeed Pro EDGE package is capable of tomosynthesis in both the standing and supine positions. However, standing and supine positions involve different FPD movements. For supine tomosynthesis, the cross-section height can be specified, so that the FPD moves along with the tube, but for standing tomosynthesis, the FPD remains stationary and only the tube moves. Therefore, the cross-section height cannot be specified [a]. That means the available radiography range is different in standing and supine positions, so additional care is required.



(a) Frontal View of Entire Lower Extremity

(b) Lateral View of Entire Lower Extremity

Fig.9

Fig.10 Markers for Long View Radiography

It takes about 12 seconds to acquire 60 images, the raw images are sent to the dedicated reconstruction workstation in about one minute after acquisition. Once it is sent to the workstation, the system is available for performing any other radiography, so there is no interference with other examinations.

As to the image reconstruction, the T-smart reconstruction method is very effective in suppressing metal artifacts. It has various modes for different types of metal objects in the body, such as artificial joints, metal plates, and screws. Image reconstruction processing will probably require experience and skill.

Now that tomosynthesis is available in the general radiography department, it has broadened the scope of observation and diagnostic possibilities and allowed us to provide higher quality images to patients.

7. Conclusion

At this point, after actually using the system for clinical applications for about one year since introducing the system, we are extremely pleased. It has satisfied all items on the wish list we prepared before relocating the hospital. The system seems to be developed from the perspective of technologists, making it very convenient and easy to operate. Providing high quality images and enabling shorter examination times have resulted in improved service to patients.

Given the very high cost of the FPD panel, we handle it with somewhat extra care, but presumably we will be using it for a long time.

Currently, we are focusing on reducing X-ray dose levels further, while also maintaining high image quality, so we look forward to Shimadzu offering even more improved technologies and new functionality in their products.

[a] (Editors' footnote) Cross-section height can be changed in the reconstructed Images