

Digital R/F

Experience of Using FLEXAVISION X-ray TV System



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1. Introduction

Seijin-Kai Medical Corporation Rakusai Shimizu Hospital (established in April 1988) is surrounded by the satellite towns of Rakusai and Katsurazaka, and is directly connected to Kameoka City and Nantan City via the Kyoto-Tanba Highway. It is an acute-care hospital with 148 beds that plays a central role in regional healthcare. It is on the north side of the Kyoto City University of Arts.

The basic principles of the hospital are "to make every effort to ensure the provision of advanced, high-quality medical care to the people of this region" and "to put the needs of patients first, to provide comprehensive explanations about medical care to patients, and to aim to provide medical care that satisfies patients and that is administered with their understanding".

The X-ray TV system that was the only analog system among all of the radiological equipment used at Seijin-Kai Medical Corporation's facilities was replaced in February 2007, thereby realizing our wish for full digitization across all facilities.

Here, we will report on our initial experiences of using the first ever FLEXAVISION X-ray TV system to be introduced in Japan.

2. Background to System Introduction

The in-patients and out-patients that receive orthopedic treatment at our hospital account for more than 30% of the total number of patients. The frequency of general radiography is extremely high, and in order to increase throughput, we use the X-ray TV room as a second radiography room. We also conduct about 40 examinations per month on digestive organs that require the use of fluoroscopy. Our department of radiology is extremely busy, and the specifications proposed as necessary requirements for equipment used in our hospital included the following. (1) It must be possible to perform all abdomen examinations, excluding angiography. (2) The second radiography room must be able to handle general radiography

required for orthopedics. (3) The equipment must be both patient-friendly and operator-friendly.

Our fluoroscopy room is not that big, and because it is also used as a second radiography room, it contains items other than those required for fluoroscopy, such as a standing-position lieder stand. Therefore, we wanted as compact a system as possible.

In addition to the basic performance of FLEXAVISION as an X-ray TV system, it can also be used in various ways as a radiographic table, and packs a lot of functionality into relative small dimensions. These factors led to its introduction.

3. System Overview

The system is shown in **Fig. 1**. The system itself is of an extremely compact design, and requires little installation space. The tabletop does not move longitudinally and so there is no possibility of making contact with items such as endoscopes or shelves, and the movement of operators and caregivers is not restricted.



Fig. 1 System Setup

The microphone in the fluoroscopy room is secured to the proximity monitor with a pin, and because the only items born by the fluoroscopy table itself are

the X-ray tube, the pressure tube, and cup holder for barium meals, there is a large amount of open space on the tabletop, making it extremely easy to transfer patients from a stretcher onto the table.

The tabletop can be moved vertically in a height range of 69 to 95 cm, allowing the selection of the optimum heights for the transfer of the patient from a stretcher or wheelchair and for the operator's approach. This has helped reduce the burden placed on the patient and the operator, and has also helped increase safety.

However, because of hardware restrictions, such as the position of the image-receiving system, at heights below a certain level or when the tabletop is inclined backwards, the movement range of the X-ray tube is limited, and care is required before starting examinations in such cases.

The imaging system has a movement range of 90 cm, and the position of the patient can be adjusted in accordance with the purpose of the examination to enable a wide variety of examinations. Examinations of regions that cannot be covered by moving the imaging system can be performed by using an optional tabletop extension.

At the side of the tabletop there is a controller used to move the table elevation, to incline the table, or to move the imaging system. Being able to perform these operations right next to the patient significantly reduces the possibility of falling.

When performing examinations with the patient in the prone or inverted position, because the image inversion switch and operation lever are linked, there is no possibility of making an elementary operating error when tracking the examination target using fluoroscopy.

This system incorporates the following fluoroscopy modes as a standard feature: continuous, 15 f/s, 7.5 f/s, and 3.75 f/s. Selecting the optimum pulse rate for the examination purpose makes it possible to reduce the exposure dose while maintaining image quality, even with procedures requiring fluoroscopy to be performed for long periods, such as IVR. Combining this with the soft X-ray filter, which is also incorporated as a standard feature, helps to realize significantly lower exposure levels than those of earlier systems.

The remote operation console also has a compact design, and because there are hardly any blind spots to contend with in remote operation, examinations can be conducted safely and securely (**Fig. 2**). The keys have been arranged in a compact way in order to facilitate the swift execution of all procedures, from operation of the fluoroscopy table to control of the generator.

The local operation console uses almost exactly the same key arrangement as the remote operation console, which makes life easier for the operator.



Fig. 2 Remote Operation Console

When registering the patient at the start of an examination, selecting the APR corresponding to the examination purpose causes the optimum preset LUT and imaging conditions to be selected. This means not only that the risk of insufficiency or excess in imaging conditions or inappropriate image processing due to human error is reduced, but also that the time required to prepare for the examination is shortened. There are also mechanisms for dealing with emergency patients. For example, clicking on the emergency examination icon causes a tentative ID number to be automatically registered. In post-processing performed after the completion of the emergency examination, the patient name and other conditions are changed and the images are output.

4. Conducting Examinations

4.1. General Radiography

Imaging of the spine and the extremities is performed in cassette radiography mode.

Cassette radiography accommodates cassette sizes of 8×10 inches to 14×17 inches, which is very useful feature for orthopedics. The X-ray aperture moves automatically in accordance with the detected cassette size, eliminating the irradiation of unwanted regions. The oblique incidence function (optional) enables the imaging of regions, such as the clavicle and the shoulder joint, that could previously only be examined in the general radiography room (**Fig. 3**). The cassette can be inserted and ejected very quickly and simply and so, even in situations involving large numbers of images, examinations can be performed without any unnecessary loss of time.



Fig. 3 Clavicle Imaging Performed Using Optional Oblique Incidence Function

The footrest and handrail can be secured in any position, making it easy to perform imaging of the lower extremities in the standing position. When performing standing-position imaging of the lower extremities in this hospital's general radiography room, because of various factors, such as the X-ray tube stroke, it was necessary to have the patient stand on top of a lying-position Bucky table. In the case of elderly or paralyzed patients, there was a significant possibility of the patient falling, and there were many cases in which imaging had to be repeated due to bodily movement.

Since the introduction of FLEXAVISION, in consideration of the various merits afforded by using the X-ray TV system, such as the low tabletop, the ability to perform imaging with the patient holding the handrail, and the ability to perform imaging on both sides without having the patient move, most imaging has been performed using this system.

For fingers, X-ray exposure is possible with the cassette placed directly on the tabletop and so there was no need to have the ceiling reconstructed in order to extend the travel distance of the second X-ray tube. This allowed cost savings.

Combining the second X-ray tube with the standing-position ladder stand enables nearly all types of general radiography, and has helped realize a significant improvement in throughput and a reduction in patient waiting time.

4.2. Fluoroscopy for Orthopedics

The main orthopedic applications for which fluoroscopy systems are used at this hospital include stress radiography, reduction under fluoroscopy, and myelography.

Because there is hardly any movement of the target region in orthopedic examinations, from the perspective of reducing exposure, pulsed fluoroscopy is a suitable technique.

In the examination of distal joints, such as the ankle, although positioning based on consideration of the X-ray tube stroke is required, except in

cases involving extremely tall patients, the examination can usually be performed without using a tabletop extension.

The handrail attachment is almost flush with the tabletop and so regions that are some distance from the trunk of the body, such as the shoulder joint, can be examined without having the patient adopt an awkward position.

With earlier systems, we often had problems of insufficient dose in, for example, lateral radiographs of the lumbar segment of the spinal cavity obtained for large patients. Since the introduction of FLEXAVISION, however, this problem has almost been eliminated.

Clinical examples are shown in **Fig. 4** and **Fig. 5**.



Fig. 4 Stress Radiograph of Ankle Joint



Fig. 5 Image of Lumbar Segment of Spinal Cavity

4.3. Fluoroscopy for Digestive Organs

We conduct nearly all types of examinations of the digestive organs.

Clinical Application

As with orthopedic examinations, because the FLEXAVISION tabletop does not move in the longitudinal direction, although the safety of examinations and procedures where it is desirable to keep the patient as still as possible, such as ERCP, is improved, care is required in positioning for examinations requiring a long stroke.

The time lag between the pressing of the X-ray exposure switch and the start of imaging is very short, making it possible to obtain images for almost exactly the desired time phase.

Using serial radiography mode enables continuous radiography at a rate of 3 f/s. This feature comes into its own in examinations of regions, such as the esophagus, that require the imaging of a quickly flowing contrast medium.

Because 14 × 17-inch cassettes can be used, this system can also be used for examinations of urinary organs, such as DIP.

Clinical examples are shown in **Fig. 6** and **Fig. 7**.

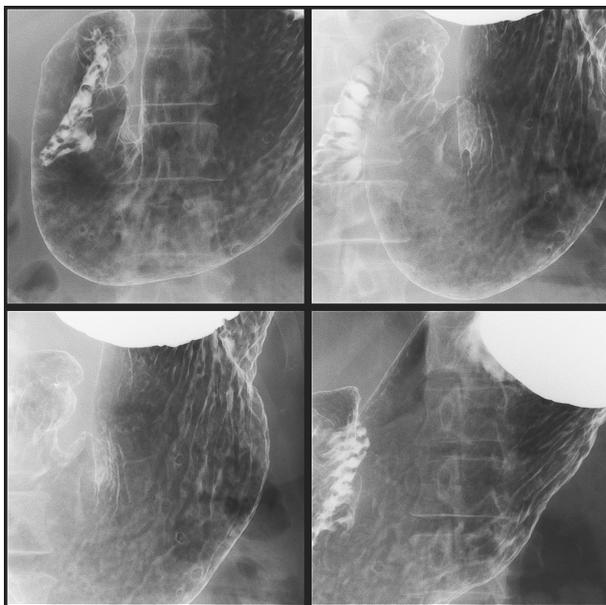


Fig. 6 Stomach Fluoroscopy



Fig. 7 ERCP

4.4. Image Processing

The image processing, measurement, and filming required after imaging can be performed intuitively using extremely easy-to-understand icons and a mouse. This helps create a stress-free working environment for the operator.

Because this system complies with DICOM, it is easy to connect to other devices in the in-house network, such as laser imagers and servers, and there is a high level of immediacy.

Although it is possible to perform simultaneous parallel processing in which radiography is performed concurrently with filming, procedures such as adding film markings are used in this hospital and so we only use this facility in certain cases.

We feel that this system is extremely useful for routine examinations, such as stomach fluoroscopy.

5. Summary

It is three months since we introduced FLEXAVISION at this hospital.

We received the first system to be delivered in Japan, and there were inevitably some problems with the software to begin with. None of these were particularly serious, though, and we are currently operating the system with no significant problems.

In addition to helping us achieve our original objective of the full digitization of all the radiological equipment used at this hospital, because of its flexibility, this system has also yielded many other benefits, including a significant reduction in patient waiting time, a reduction in exposure to the operator and the patient, and an improved level of efficiency.

Before the introduction of FLEXAVISION, the function of the second radiography room was inadequate, and we always had a lot of trouble in periodic inspections of the first radiography room. Now, however, we can handle almost all of our radiographic needs, and these problems have been solved.

In facilities like ours, where there is a large demand for general radiography and fluoroscopy examinations, FLEXAVISION can, as its name would suggest, respond to these needs in a flexible way.

It is not long since FLEXAVISION was introduced and so we have not really had enough time to give it a proper clinical evaluation. However, there have been no serious problems with it so far, and it is being utilized effectively in clinical applications.

In the future, as a result of collaborations between this hospital and Shimadzu Corporation, we are looking forward to seeing experience with both hardware and software used as feedback for the further development of X-ray TV systems that can be used for a wide variety of applications.