Transillumination

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This chapter deals with the basic operation of fluoroscopy equipment and its application in medicine.

The fluoroscopy technique is used for:

- Reduction of bone fractures,
- Examinations of the gastrointestinal tract and other body cavities using contrast media,
- Examinations of vessels also with contrast media,
- Placement of probes or drains in the body.

Of particular importance is the consideration of real-time processes in the study of the swallowing act.

The X-ray contrast media used are adapted to their field of application (► Chap. 9).

In fluoroscopy, the use of contrast agents allows structures to be depicted that are otherwise difficult to visualize due to the small differences in density compared to the surrounding tissue.

4.1 Image Intensifier (BV)

The image intensifier consists of an evacuated, i.e. airless, glass or metal bulb. The slightly curved entrance surface of the X-rays is coated with a luminescent material (caesium iodide). This layer produces a **luminescent image** when the radiation hits it. A photocathode is applied directly to this luminescent layer, which emits electrons corresponding to the luminescence image, the so-called **"electron image"**. These electrons are accelerated towards the anode by the applied voltage of approx. 25 kV–35 kV.

Further electrodes are attached to the outer wall inside the glass bulb. Their negative charge ensures that the free electrons are focused on a specific point (= **electron optics**).

Beyond the focal point, the electrons also strike the output screen, and the resulting luminance image is brighter, inverted, and reduced in size.

This change in brightness is caused by the acceleration of the electrons inside the image intensifier and by the higher electron density in relation to the area compared to the input screen.

The resolution plays a big role. If the layer is too coarse, small details can easily get lost.

Depending on the circuit of the electron optics, the scale of the **electron** optical **reduction** can be changed by shifting the focal point. Thus, only a small area of the input screen can be displayed on the output screen to show details.

The image of the output screen is recorded by a camera and displayed on a monitor. This is done by means of a so-called **tandem optics**, i.e. two lens systems that forward the image of the output screen to the camera system.

The image of the fluoroscopy is displayed on a monitor in the examination room. Due to the **"Last-Image-Hold** (LIH)" function, the last image on the monitor is retained and can be digitally stored, thus replacing an additional X-ray image.

Since the image should be constant during fluoroscopy, regardless of the area being fluoroscoped, the electronics on the output screen also control the generator power of the X-ray tube, among other things.

Because of the automatic dose control, never hold or place a lead glove or other opaque object (e.g., scissors, etc.) in the radiation path. This procedure increases the X-ray dose for the patient and the examiner, as the generator regulates the dose upwards until the object is transilluminated.

4.1.1 Structure of A Fluoroscopy Unit

A fluoroscopy system consists of an X-ray tube, a patient positioning table, an image receiver and (in the case of digital systems) an evaluation unit.

In the meantime, mainly under-table units are used, in which the tube is located below the table. For optimal adjustment, either the table can be moved or the X-ray unit can be moved above the patient. In addition, the entire system consisting of the target unit, tube and table can be tilted so that examinations can be performed with the patient standing (e.g. swallowing studies) or with the patient in the head or foot down position (e.g. phlebography—examination of the deep leg veins).

In a fluoroscopy-only unit, the tube image receiver unit cannot rotate around the patient. To take a lateral image, the patient must rotate on the table.

Practice Questions

► Chapter 5