Radiographic Calibration in Metron

Small Animal

Metron Version 5

Introduction

Due to the nature of the geometry of radiographic imaging, all radiographs have inherent ***magnification*** in them. For example, if one puts a ruler on a radiographic film, the measurements one would get are not true size of the radiographed objects, but rather they would measure larger than actual size.

Small Animal Table Arrangement

Figure 1 shows the physical setup. The two numbers shown are constant.

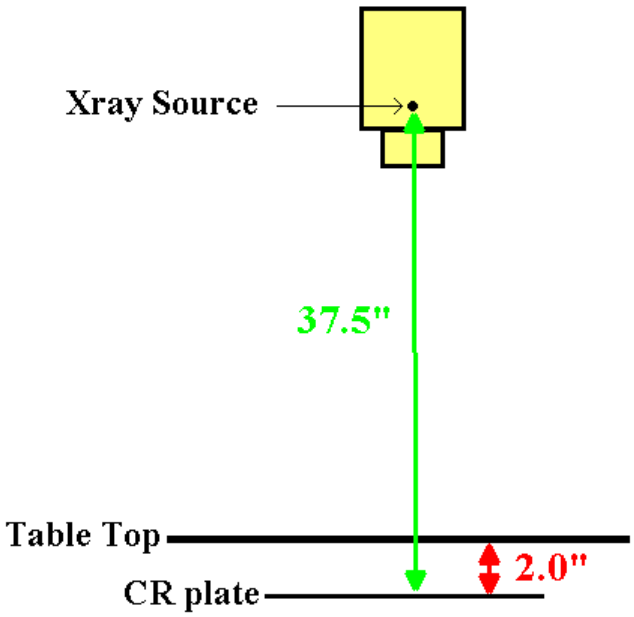

Figure 1: The two fixed offsets of importance in your table setup.

Concept: The "Plane of Interest"

To be precise with radiographic calibration, it is not possible to simply program constant offsets into the imaging software. This is because it is animal dependent and view or procedure dependent exactly where the calibration is needed. An important concept is the "plane of interest" which is a plane, parallel to the imaging plate, but offset some distance towards the generator. Calibration can be used so that accurate measurements can be made in this plane of interest. But, this requires that

A) The practitioner decide where the "plane of interest" should be, and
B) The imaging software must be told where this "plane of interest" is located.

For example, for a companion animal lying on a table, the best general choice for the plane of interest would be at about half the body thickness – approximately the plane containing the animal's spine. However, if you were shooting radiographs intended for pre-surgical planning for TPLO or TTA, or some other specific anatomy, the ideal choice for the plane of interest is the plane most nearly containing those anatomical features you intend to measure. Figure 2 shows the best general plane for a small animal lying on the table.

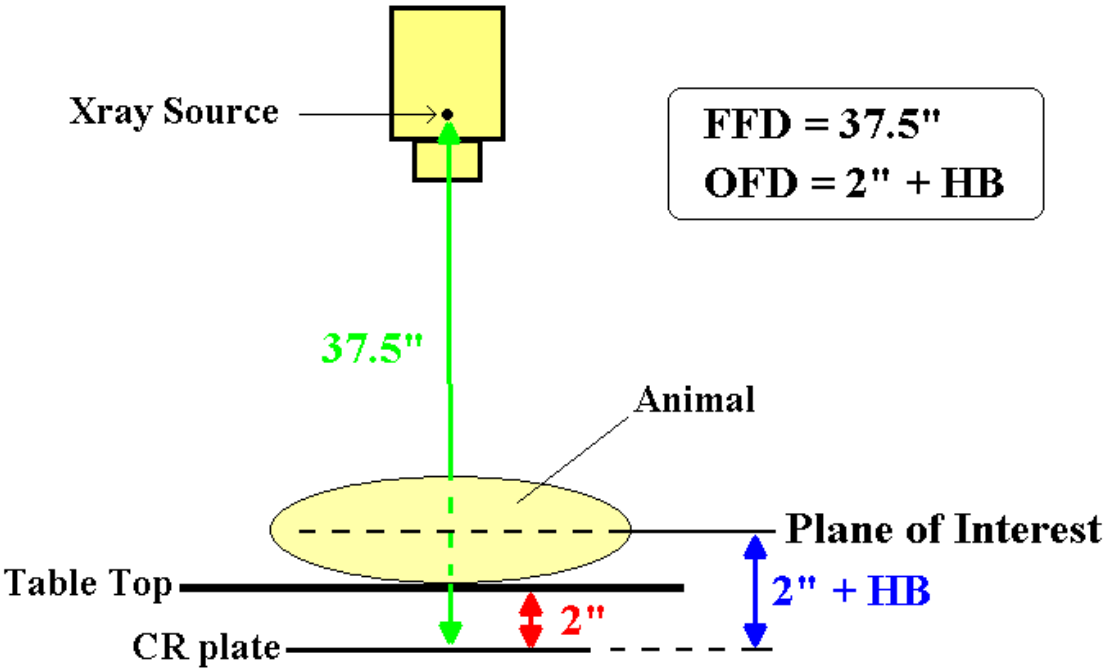

Figure 2: The best general choice is to locate the "plane of interest" at a distance above the table corresponding to half of the animal's thickness.

FFD, OFD, and Magnification Factor

In the Metron software we use the terms Film Focal Distance (FFD) and Object Film Distance (OFD) to describe the physical set up and location of the plane of interest. The FFD is the distance from the source of X-rays to the imaging plate, and OFD is the distance from the plane of interest to the imaging plate.

Given these values, the magnification factor evident in the radiograph is:

$$\mathbf{M = \frac{FFD}{FFD - OFD}}$$

For example, for an animal that is 6" thick (so "HB" in figure 2 is 3") we have the values:

FFD = 37.5"
OFD = 5.0"

Which gives a magnification factor of 1.154. This means everything in the image is 11.54% bigger than true size. For all the films you shot on this system, if you were to measure with a ruler on the film, a 10" distance along the spine would measure 11.54" with your ruler.

Pragmatism and General Use

A great majority of radiographs of interest to veterinarians are not used for measurements in any way, so none of these issues of calibration matter at all. In some uses, for example the "Veterbral Heart Score" technique of checking for enlarged hearts, the scheme has been designed in such a way that a calibrated image is also not required (the size of a vertebra is used as the scale factor).

However, in some procedures measurements are important. It is also our belief that the small amount of extra effort that must be expended to ensure calibrated images should be expended for all images as a matter of standard practice. Veterinarians spend a great deal of money for diagnostic imaging, and they should be able to have the benefit of accurate measurements in the images obtained.

The current state of the art is that very few veterinarians think about calibration, and support for it in the major CR and DR systems on the market is generally lacking. The solution adopted by some vendors is simply to add a line to the radiograph's annotation that states "Scale is approximate".

Radiographic Calibration in Metron

Metron supports several schemes to achieve calibration due to the number of different systems and situations we work in. In some schemes, knowledge of the FFD and OFD are not required at all – but these schemes require that a special marker was placed in the plane of interest when the image was acquired.

Metron-Scaler…

The easiest and best ways of calibrating require a marker of known size placed "in the plane of interest". To this end we sell a little widget called the "Metron-Scaler" which works well. It can be velco-strapped to a leg, or placed at 'mid body' or, if super-accurate calibration not required, can simply be placed on the table (hence, lower than 'mid body' unless you are shooting a squirrel!).

The "Metron-Scaler" will be automatically located by the Metron software (most of the time - something obstructs it or if the exposure is off, it may not find it, then you simple pick two points on it and you are calibrated.)

Pick 2 Points…

Next easiest is something metallic of your own that you may have that could be placed. In this case, Metron won't automatically find it, but you can use the calibration option to "Pick 2 Points" that are a known distance apart and you are calibrated -- so, very easy.

Known Pixel-Pitch…

Now on to ways that require knowledge of FFD and OFD:

If there is no scale marker "in the plane of interest" then the only way to get calibrated is to know the relationship between pixels and physical length on the CR plate, and also to know the FFD and OFD so that Metron can do the math to transform all measurement into a plane parallel to the CR plate, but offset from it (the "plane of interest"). This is known as the "Known Pixel Pitch" method of calibration.

In the case of CR, Metron knows the scan setting used. But to transform the measurements (that is, to "take the magnification out") we must have the FFD and OFD, and this is entered into the calibration panel. In case you want an approximate plane of interest always to be a certain height off or your table, you can enter these values once, and you'll see that Metron will "remember" values put in for FFD and OFD from session to session.