Technical revolution – the pros and cons of digital radiography

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Categories : RVNs

Date : November 1, 2009

Tim Watson PhD, BVM&S, MRCVS, shares his experiences of going digital and explores the options for the modern-day practice

IF you are reading this, then I would wager a significant number of you are presently using traditional x-ray film and wet chemistries to obtain your radiographs. It's a pretty safe bet, because those of you fortunate enough to have "gone digital" need no persuading of the advantages that digital radiography brings to practice life.

It is only some five years ago that digital radiography was touted as the newest veterinary toy; the latest in a line of diagnostic innovations that stretched from fibre-optic endoscopes and ultrasound scanners to video endoscopes. But digital radiography was always more than just a toy and, in the intervening time, it has pretty much become the industry standard in both small and large animal practice.

We went digital two years ago and I was immediately seduced by its convenience and speed. No more messy chemicals to store and dispose of, no dark room to stumble around, and no need to re-take films that were under or over-exposed. I could take a full set of vetting x-rays in an hour, when it previously took twice that length of time. And my younger colleagues soon took advantage of the technical gizmos on offer: zooming in and out, calculating distances and degrees, adding labels and annotations.

While we all love our digital system – and would hate to go back to chemically developing x-ray

film – the purpose of this article is to provide a dispassionate view of the pros and cons of converting to digital radiography.

The first point to make is that the majority of digital systems allow you to continue using an existing x-ray machine to take your radiographs. It is how the x-rays are detected, viewed and stored that is different, and there are essentially two digital systems: computed radiography (CR) and direct digital radiography (DR).

Computed radiography

Computed radiography employs cassettes almost identical in appearance and size to conventional cassettes, which means those of you in equine practice can continue to use existing cassette holders and grids. In the CR cassette, the x-ray image is recorded on to a phosphor plate that is subsequently read and digitised. This is done by loading the cassette into a computed reader that functions along the lines of a conventional automatic developer (Figure 1). But, instead of the image appearing on film, it is transferred from the phosphor plate in the form of a digital file viewed on a computer screen.

It generally takes one to two minutes to process a CR cassette. While this is similar to the throughput of conventional automatic processors, it does not necessitate the added time of going to a dark room and the fumbling involved in unloading and reloading film. Digital cassettes can be developed one at a time at the patient's side, and image positioning and quality checked immediately before taking the next view. This really does speed up the taking of multiple images.

Direct radiography

Direct digital radiography is different in that the cassette is connected to a computer that allows instant visualisation of the image. The cassette may be mobile – albeit attached by a cable to the computer – or integrated into a radiography table (Figure 2 and 3). This system is much quicker to use since it doesn't require processing of the cassettes. It also offers large animal vets the advantage of being able to see the x-rays as they are taken at a client's premises.

Undoubtedly, the biggest technical benefit of digital radiography – both CR and DR – is the flexibility in image viewing. You can manipulate the image with respect to its orientation, brightness and contrast, and correct for a degree of under or over-exposure without having to re-take the picture. This is a property of the wide latitude or dynamic range of digital radiographs, relative to conventional screen and film systems.

The wide latitude of digital systems also makes it possible to image soft tissue and bone on the same plate, as well as to visualise relatively thick (for example, the pelvis) and thin (for example, the stifle) body areas with a single exposure. It should be noted, however, that digital systems will not compensate for poor radiographic technique and do not correct for movement, bad positioning

or scatter from inadequate collimation.

Our digital x-rays are much “neater” than the old films because the names of the patient and its owner, as well as the date, are recorded on each image. Left and right positional markers can also be added to the image. No more trying to find a piece of card for the film writer, or scribbling in permanent marker on the film.

Software on the computer where the images are viewed also allows us to zoom in on a particular region and make measurements. The latter is of particular benefit for orthopaedic surgeons measuring up implant sizes. We can also calculate angles – perfect for assessing the degree of laminitis – without having to steal the protractor from my son’s school bag.

These image handling features enhance our ability to demonstrate and explain radiographic findings to owners, especially when we can instantly load a “normal” image from another patient for comparison. It is much more professional sitting down at a screen with a mouse-driven cursor than holding a flapping film up to the light while trying to point with an old biro.

Owners usually appreciate being given a copy of the images on CD; I doubt whether it is ever viewed, but it does involve them in the diagnostic process and help them appreciate the value of what they are paying for.

Our digital images are stored on the computer, which is periodically backed up, and on CD. This takes up considerably less room than storing conventional films and does make retrieval quicker and easier, since there is less danger of images being misplaced or filed incorrectly. However, you do have to be careful to input the names of the patient and owner correctly – I have spent too much time searching the computer for Tilly MacKenzie’s x-rays only to find them under Tillie McKenzie.

Digital x-rays are, by convention, stored in a format called DICOM, which stands for digital imaging and communications in medicine. This is a universal file format, developed by the American College of Radiography, which allows images from any digital system to be viewed on one workstation. While the images may be manipulated in terms of their magnification, brightness and contrast, it is impossible to alter the patient details and date. Because DICOM files are large and owners can find them difficult to handle, we export images for owners to CD as JPEG files.

Belt and braces approach

The back up and CDs are stored separately and away from the radiography station. Such a belt and braces approach is essential in avoiding catastrophic losses that might otherwise result from damage to, or theft of, the computer, or a fire. Our radiography computer stands alone and is not connected to the practice network or internet. I feel that the latter is particularly important to prevent potential infection by viruses, trojans or other malicious software nuisances. There is a downside to this in that, when we want to email x-rays for another opinion or to incorporate in a report, these

have to be burned to CD or transferred on to a memory stick.

Digital radiography is sometimes promoted on the basis that it is safer because staff and patients are exposed to lower doses of radiation. This is not necessarily true. The need for fewer repeat x-rays does reduce the number of exposures but this is often offset by the fact that greater exposure factors – up to 20 per cent higher – are used with digital systems. Also, since digital is much more tolerant of over-exposure than under-exposure, there is a temptation to crank the kV or MAS up just a little bit more to avoid under-exposure.

A final advantage of digital radiography is that it negates the need to purchase, store and dispose of developer and fixer chemicals. Also, you no longer encounter the annoyance of finding the last box of x-ray film empty, or a nearly full box that has been left open and exposed to daylight. Gone too is the monthly ritual of emptying, cleaning and replenishing the automatic developer, as well as the frustration and additional work that results from dirty rollers or chemicals that have gone off earlier than anticipated.

Drawbacks

But, surely there are some negatives associated with digital radiography? Yes is the answer, with the biggest drawback being the cost of the equipment. Buying a set of CR cassettes, the developer and associated computer with a high-resolution monitor will cost in the region of £20,000 to £30,000 depending on the system and specification. And you can expect to pay a similar or slightly higher amount for a DR system. Annual maintenance plans cost £1,000 upwards, depending on the cover provided.

Switching to digital is a “no brainer” if your existing automatic developer breaks down, but otherwise requires careful thought, especially in smaller or branch practices where the throughput of x-rays is lower. The initial capital cost is offset by the fact you will no longer be buying film or chemicals, or have the expense of disposing of waster chemicals. These savings will, however, be lost if you decide to print hard copies of your radiographs, or if you keep the old automatic processor as a back up.

Going filmless

We took the decision to go completely filmless when we went digital – we gave our automatic developer and cassettes/ screens to a small local practice and do not print the images. After all, nothing drains a printer cartridge quicker than the black background of an x-ray image. For animals going to surgery, we load the necessary images on to a laptop that is taken into the theatre.

The change may also not be entirely straightforward. Some effort is required to recalculate exposure settings and we are still refining these after two years of use. The supplier of our system was very helpful in giving initial guidance. The equipment does provide an exposure index for each

image, which is compared with a target value and guides us on fine-tuning the settings. Staff will also take time to familiarise themselves with the new equipment and develop appropriate protocols for image storage and back up.

Do not necessarily assume that the x-ray images will be much better than you achieved with your old system. The reality is that a good digital image is only comparable – not superior – to a high-quality film picture. But a poor-quality digital image is inevitably made better than a poor film because of the processing of the image by the system's software. Digital radiography has also been associated with a range of image artefacts that are beyond both me and the scope of this article; they are discussed in detail in Abby Caine's well-illustrated article in *In Practice* (2009) **31**: 334-339.

Our CR system has proven to be robust and reliable, coping well with demands of use within the clinic and out at equine clients. We looked at a DR system but were concerned whether the imaging panel and its cable connection to the laptop computer – which are the expensive components – would withstand being kicked or stood on by a horse. This was a personal choice and I am well aware of equine practices that have, and enjoy using, their DR systems. The development of wireless DR systems will be a major step forward, but was not one we were prepared to wait for.

And one final piece of advice: since a number of suppliers are actively selling dedicated veterinary digital systems, it is well worth trying several set-ups in your practice – whether it is small animal, equine, large or mixed – before getting the boss to write the cheque.