Film vs Digital – How Do They Compare?

There is a common misconception among consumers that digital x-rays use significantly less radiation, with claims ranging from “90% less” to “it uses no radiation at all”! The truth is that depending on the procedure performed and the system used, digital x-ray doses in dentistry can range from slightly MORE radiation compared to film, to significantly LESS radiation. While dose is one important factor to consider, digital x-rays offer several other significant advantages over film and should be the imaging modality of choice whenever possible.

Certainly one of the most significant benefits of digital x-rays relates to the environment. The elimination of chemicals and metals in the sewer system combined with less paper, plastic and lead foil in our landfills makes digital x-rays the clear winner in any comparison with film. However, environmental benefits tend to be less personal, and when it comes to individual patient health decisions, three equally important issues immediately come to mind. They are Dose, Image Quality, and Portability

1) Dose – For many patients, radiation dose is the single most important factor when considering an x-ray procedure. While digital x-rays have gotten a lot of publicity in the dental world recently being touted as “90% less radiation”, there are several important factors to consider in regards to this claim. By far the most important is the fact that digital x-rays are not all the same!

For extra-oral x-rays – those taken “outside” of the mouth - there is little difference between film and digital. These procedures include the digital Panoramic, which is the same dose as film, and the digital Lateral Ceph, which can be less dose than film, but not significantly (see Visser, Rodig, Hermann, Angle Ortho Vol 71, No. 3, 2001). Digital extra-oral images offer several other significant advantages over film, but as far as dose is concerned, both are essentially the same.

On the other hand, the intra-oral x-ray - taken “inside” the mouth - is where much of the confusion comes into play. Currently there are two digital systems available for intra-oral x-rays. The “Direct Digital” (DR) system, used by many private practice general dentists, uses considerably less radiation than film and can often live up to the claim of a “90% reduction”. However, this system has several significant limitations which can make it less suitable for the dental laboratory setting.

The “Phosphor Screen” (CR) system, used by many dental x-ray labs or imaging centers, uses slightly more radiation than film, but offers additional features and more flexibility than DR systems. Included are multiple size options, reduced patient discomfort, and ease of use and positioning for the operator. If the initial dose was the ONLY factor being taken into consideration, the best option for most patients would be to have a general dentist take their intra-oral (FMX) x-rays using a DR system prior to visiting the lab for the remaining procedures.

However, there is another “dose” that needs to be taken into consideration. For this discussion, we call this the “Secondary” dose, which is additional exposure received when procedures need to be repeated (re-takes). There are three primary reasons for re-takes. They are Patient Movement, Positioning Errors, and Exposure Errors.

Patient Movement generally relates to the skill of the operator in positioning the patient in a way that will reduce the possibility of movement, as well as the ability of the patient to remain still during the procedure. Both film and digital x-rays use similar positioning devices and aids. The digital Lateral Ceph uses a 15-20 second scan which increases the possibility of patient movement, especially in young children. However, proper patient preparation is usually sufficient to minimize this increased risk of movement. In terms of patient movement, there is very little difference between film and digital.

Positioning Errors are generally related to the skill of the operator as well as the cooperation of the patient. In most cases, there is little difference between film and digital, with one notable exception. DR intra-oral systems tend to be less comfortable and more difficult to position, making them prone to positioning errors and re-takes. Much of the advantage of the lower dose DR systems will be negated if the x-rays do not contain sufficient information due to improper positioning, or must be re-taken due to patient movement.

Exposure Errors are fully the responsibility of the operator. Using either digital or film, a highly skilled operator should have few if any exposure errors. However, mistakes happen and misjudgments occur. This is where any digital system shines when compared to film. Virtually all exposure errors can be “fixed” using software during
post processing, eliminating any re-takes and all “secondary” dose due to exposure errors. Additionally, “marginal” films, which are not ideal but not worthy of being re-taken, can often be manipulated with digital systems to enhance the image quality, increasing the diagnostic information available.

When considering dose alone, digital x-rays can range from a small advantage over film when using CR systems, to a large advantage over film when using DR systems. However, re-takes and operator errors can significantly reduce this advantage, so on a scale of 1 to 5, with film being the standard “3”, we give digital a score of “4”.

2) **Image Quality** – The optimal dental intra-oral image would be a “D” speed film, properly positioned, exposed, and hand processed using liquid chemicals. This “wet film” system can be considered the “Gold Standard” against which all other films are compared. In reality though, there are many things that can go wrong in this process, making the optimal image very elusive. Consequently, in exchange for a slightly lower image quality, the industry has accepted a faster and more consistently reliable process, which is what you will find in most dental offices that still use film. This is where the advantage of digital x-rays becomes more significant. Film is film, and once exposed and processed, it can’t be altered. Digital images on the other hand can be enhanced significantly using software to bring out the maximum information on the film. Images can be darkened, lightened, sharpened, colorized, enlarged, inverted, and transformed in a variety of other ways to squeeze out every possible benefit from the image. Bad images can be made good while good images can be make great, all with a few mouse clicks and a basic knowledge of software tools. Additionally, conventional extra-oral films use screens to reduce dose (which also reduces image quality) then often add other enhancements to bring back the lost image quality. With digital systems, the image quality is significantly better than film without any screens or other enhancements to interfere with the image. A sharper clearer image is much easier to read making diagnosis and treatment more successful. The higher initial image quality combined with the ability to enhance digital images is so significant that on a scale of 1 to 5, with film being the standard “3”, we give digital a score of “5”! If it weren’t for the next factor, image quality could possibly be the single most significant reason to choose digital over film.

3) **Portability** – The ability to easily copy and distribute digital images surpasses all other factors in comparing film to digital x-rays. With film, there is only ONE original. Films can be duplicated but there is always a loss of quality with duplication, and often films are lost or damaged before they can be duplicated. If a film is damaged, misplaced, or “lost in the mail”, it is gone and cannot be replaced. Digital images on the other hand are ALL originals. Every copy is an original and there is never a loss of quality. Patients can retain their own personal copies, images can be sent to insurance companies, second opinions can be rendered, specialists can be consulted, and patients can change doctors, all without needing to re-take or even re-print the images. Email, CD, and duplicate prints are all available from the original images that are stored at the imaging center. So, on a scale of 1 to 5, with film being the standard “3”, we give the portability features of digital images a score of “5”!

Clearly, digital x-rays offer many advantages over film, with **Image Quality** and **Portability** being the most significant. There are also considerable **environmental** benefits as well as the possibility of a **radiation dose reduction** in some cases. Patients seeking to take full advantage of the benefits of DR digital imaging systems are advised to contact their imaging center to discuss whether or not the trade off of using two imaging facilities is worth the additional cost and inconvenience to the patient and their doctor.

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