Clinical Showcase

Converting Your Radiographs into Digital Format

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Dental practitioners who have film-based radiographs in their patient charts may want to convert these into digital images in order to incorporate them into electronic patient databases; create a backup for the original film-based images; transfer the images on a compact disc (CD) or by e-mail (e.g., for referral to a specialist); or use the images for electronic presentations or lectures (e.g., when using Microsoft PowerPoint).

This article briefly describes the method that the authors have developed to convert radiographs into digital images. Other equally effective methods likely exist.

Requirements

1. A good quality flatbed scanner with a transparency adaptor (**Fig. 1**). Use a good quality piece of equipment from a reputable manufacturer that will provide technical support when needed. A transparency adaptor is essential to obtaining acceptable digital images from radiographs.

2. A computer with a minimum of 512 megabytes of RAM, a high-speed processor, and a hard drive with ample free disc space.

3. A graphics or image processing software program (e.g., software that will allow the manipulation and adjustment of digital images, such as Adobe Photoshop, Photoshop Elements or Jasc Paint Shop). You do not need software that a professional photographic laboratory might use, but you require a program that will allow some basic image processing as described later in this article.

4. A CD burner to back up or store created images.

5. An image archiving software program (e.g., ACDSee or RadFiler) to organize, locate and view images quickly.

Scanning Technique

Remove all staples or other sharp objects from the original radiographs to prevent scratching the glass on the scanning bed. Also, check that the film and the glass on the scanning bed are free of dust and fingerprints.

Intraoral Radiographs (Periapical, Bitewing or Occlusal Radiographs)

Remove the film from its mount to ensure that the entire extent of each image is scanned and that the film is in direct contact with the scanning bed. It is preferable to scan no more than 4 films together at one time. Otherwise, individual periapical or bitewing images may be too small to view adequately on the computer monitor once the digital image is created.

Place the film(s) on the scanning bed, with the film edges parallel to the edges of the scanning bed. Use black opaque blockers (e.g., thin black cardboard, black film) to prevent extraneous light appearing around the edges of the films (**Fig. 2**).

Using the "Transparency" option (**Fig. 3**), choose "Preview" scan (**Fig. 4**). On the preview image, outline the area you wish to scan, including the entire extent of all films in the scan area (**Fig. 5**).

Scan in "Grayscale" (**Fig. 6**) at a scanning resolution of 500–600 dots per inch (dpi), with the image scaled to 100%. With these settings, the scanned image will have the same dimensions as the original (**Fig. 7**). Make sure you are creating an "8-bit" TIFF image with your scan (this may be the default setting of the scanning software) (**Fig. 8**). Name the file using the suffix ".tif" at the end of the file name. This should allow the file to be read by most graphics software programs on other computers.

Panoramic and Other Extraoral Radiographs

Align the radiograph on the scanning bed so the entire extent of the image can be scanned. The scanning technique is the same as described above, except you can reduce the scanning resolution to 400 dpi. Again, scale the image to 100%. When selecting the area to scan, you should exclude unexposed (white) areas at the edges of the radiograph.

Figure 1: *Flatbed scanner with transparency adaptor.*

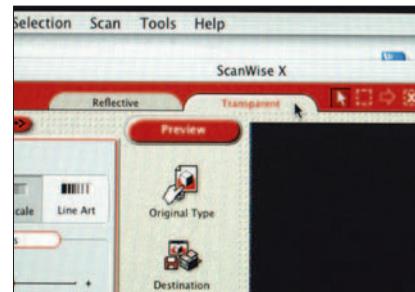**Figure 2:** *Four dental radiographs on bed of scanner, surrounded by black opaque blockers.*

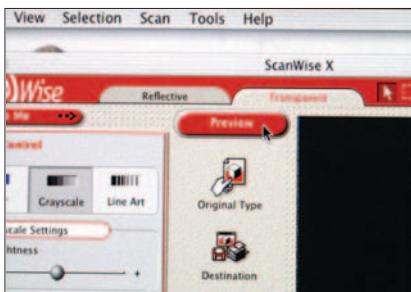**Figure 3:** *Use "Transparency" or "Transparent" option when scanning.*

Figure 4: *Choose "Preview" scan first.*

Figure 5: *Preview image with area desired for final scan outlined.*
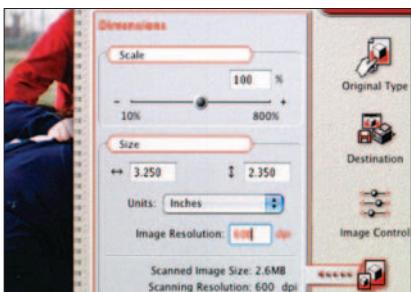

Figure 6: *Scan in "Grayscale."*

Figure 7: *Scan at 500–600 dots per inch (dpi), at 100% scale.*
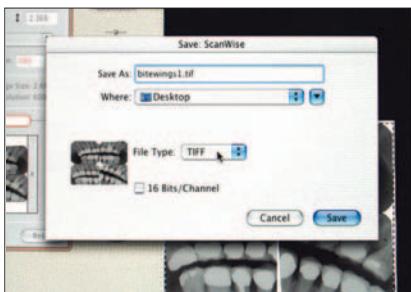

Figure 8: *Create a "TIFF" file when you make your scan. Do not check the 16 Bits/ Channel box, as this will create a needlessly large file.*
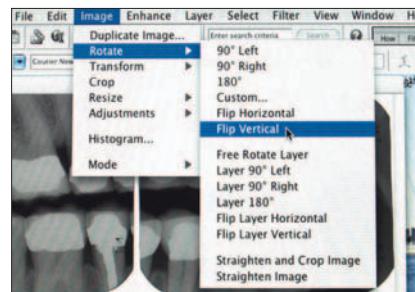

Figure 9: *Correct the alignment of the scanned image to match the original radiograph(s).*

Post-Scanning Adjustment

After the scanned image is created, open the file in a graphics software program. These programs allow you to customize or refine the appearance of the scanned image. If necessary, correct the alignment of the image so it corresponds to the orientation of the original radiograph (**Fig. 9**). Adjust the brightness and contrast as required (**Fig. 10**). Some software programs allow an automatic correction of the contrast (**Fig. 11**). Remove some "Noise" or graininess from the image by using the "Despeckle" or similar command (**Fig. 12**). When the image is suitable, save it to the hard drive of your computer. Perform this image processing using the original TIFF file, then save the changes in TIFF format (with the ".tif" suffix).

A TIFF image is usually a large file size, but it can be compressed by removing some of the information it contains, much of which is not visible to the eye. To compress an image, choose "Save as" (**Fig. 13**) from the File menu of the graphics software program (some software has a "Save a copy" command). Choose to save the image (or a copy of it) as a "JPEG" file (with the ".jpg" suffix) (**Fig. 14**). JPEG compression removes varying amounts of information contained in the original TIFF image. The amount of information removed depends on the amount of image compression chosen. When you first start compressing a TIFF image to create a JPEG, choose a "Medium" level of JPEG quality (i.e. a medium level of compression) (**Fig. 15**). Compare the appearance of the JPEG image to
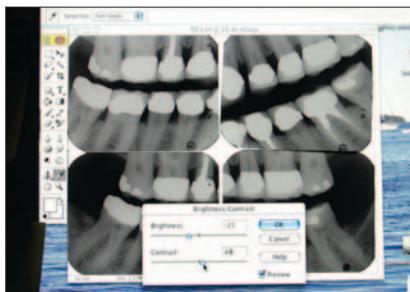
Figure 10: *If desired or required, adjust the brightness and contrast of the scanned image.*
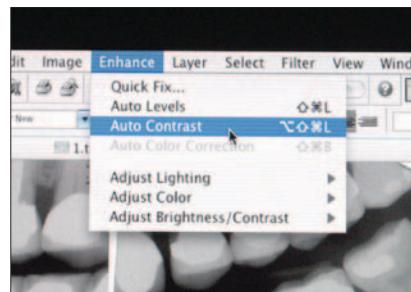

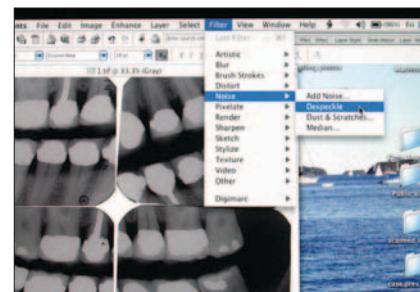**Figure 11:** *The software program may allow you to do an automatic correction of the contrast.*

Figure 12: *Using the "Despeckle" command reduces the "Noise" or graininess of the final image.*
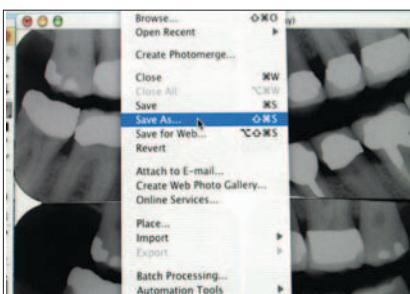

Figure 13: *To compress (reduce the file size) of the scanned image, first choose "Save as" or "Save a copy."*
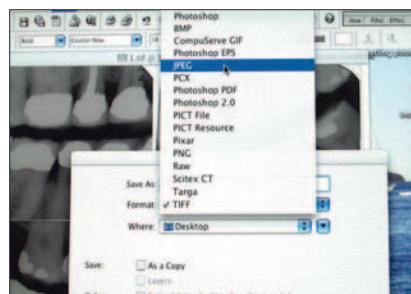

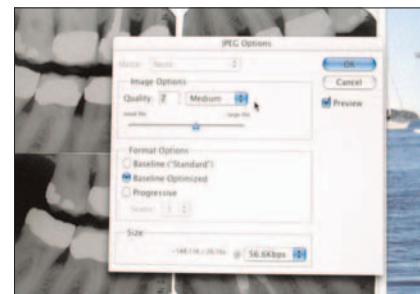**Figure 14:** *To compress the scanned image, save it as a "JPEG" file.*

Figure 15: *When creating a JPEG image, first try a "Medium" level of compression.*

Tips on File Size

When scanning radiographs to create electronic images, you are trying to find a balance between reasonable file size and image quality. Here are some tips for achieving this balance:

- File size increases with the scaling of the image. Avoid scanning at greater than 100% scaling.

- File size increases with the size of the area scanned. You should, however, scan the entire area of the original radiograph so that the resultant digital image includes the same information. If you only need a portion of an image for a presentation or similar purpose, you can copy the original TIFF or JPEG image, and crop the area you require using your graphics software program.

- File size increases with scanning resolution. Do not scan at resolutions greater than those described in this

article; in some cases, slightly lower resolutions may suffice. Generally, the smaller the original film size (e.g., a periapical film vs. a panoramic film), the higher the scanning resolution required.

- Colour images have a larger file size than grayscale images. Avoid scanning in colour. If you are not satisfied with the results from scanning in grayscale, you may wish to try scanning in colour, but if you do, be sure to convert the image to grayscale during post-scanning adjustment.

- File size will be significantly larger if 12- or 16-bit digitization is chosen for scanning. Use 8-bit digitization, as this should be sufficient.

- JPEG compression allows smaller files to be created, most often with no visible loss in diagnostic quality. You may need to experiment with varying degrees of JPEG compressions.

the original TIFF image. Be sure to always retain a copy of the original TIFF image when performing these JPEG compressions. If you are not satisfied with your initial JPEG compressed image, you can vary the degree of compression until you get a satisfactory result. It is often the case that a JPEG image of medium or low quality will

look virtually the same as the original radiograph, or the original grayscale TIFF image.

Try to avoid high levels of JPEG compression (i.e., low-quality JPEG images). You may find that the observed image quality of a low-quality JPEG is unacceptable for viewing, or may not contain all the necessary information.

You can store the grayscale TIFF images in your computer or server as part of your electronic patient database. However, you will use less hard drive disc space if you store the JPEG images instead. JPEG images usually open faster on your computer, and are more suitable for use on a Web site or in an electronic presentation as they download quickly.

Once you have saved the JPEG images, the original TIFF images can be deleted or recorded onto CDs or other media for backup purposes.

Conclusion

Scanning original radiographs allows you to create digital images that can be as diagnostically acceptable as the original radiographs, and can also be used in electronic patient databases or for other technological purposes.

This article illustrated the particular scanning methods developed by the authors. Readers may need to experiment to obtain results that are acceptable for their own needs. ❧

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