A Comparison of Three Digital Cameras for Intraoral Photography

TIZIANA DOLDO, MD, DDS
GIORGIO FIORELLI, MD, DDS
BIAGIO PATANÈ, MD, DDS

The purpose of this article is to review and compare three digital cameras that are suitable for orthodontic intraoral photography and range in price from $600 to $1,000. These models—the Agfa ePhoto 1680, the Nikon Coolpix 950, and the Olympus D-600L—were reviewed according to criteria listed in a previous article[1] (Table 1). We also considered ease of use, since this is one of the most important factors in determining whether a digital camera will be used routinely in an orthodontic practice.

Test Conditions

All three cameras were used by the same two operators, who gave independent judgments. We actually reviewed the previous model of the Nikon, the Coolpix 900s, which has since been replaced by the Coolpix 950. Because these models have the same lens and autofocus system, however, our review of the Coolpix 900s can be used as a reference for the new camera.

Both intraoral and facial pictures were taken, but since no particular problems are involved in facial and profile imaging, only intraoral photography is considered in the following reviews.

For intraoral photography, each camera was tested with a 3× close-up lens, making it possible to reach a 1:2 magnification ratio. This made the clinically useful resolution equal to the resolution of the camera's charge coupled device (CCD).

Agfa ePhoto 1680

This camera (Fig. 1) is extremely easy to use for orthodontic photography. The CCD resolution of 1343 × 972 is completely usable in intraoral photography at a 1:2 magnification ratio with the 3× close-up lens (Fig. 2). The camera can take pictures at an even higher resolution,

Fig. 1 Agfa ePhoto 1680 digital camera.

Fig. 2 Agfa 3× lens allows intraoral photos to be taken with 1:2 magnification ratio.

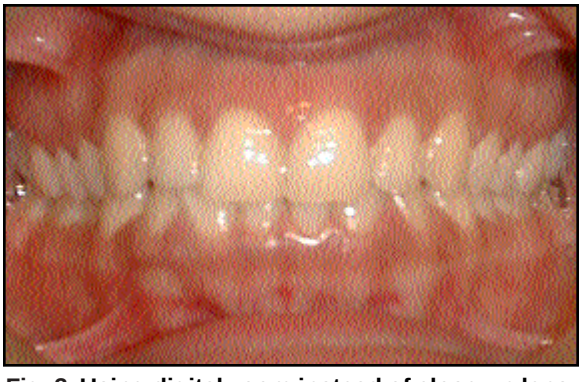

Fig. 3 Using digital zoom instead of close-up lens, even with magnification ratio of nearly 1:1, decreases resolution to 640 × 480 and thus reduces image quality.

From the Department of Orthodontics, University of Siena, Italy. Dr. Fiorelli is in the private practice of orthodontics at Via XXV Aprile, No. 23/A, Arezzo 52100, Italy.

Dr. Doldo

Dr. Fiorelli

Dr. Patanè

TABLE 1
CAMERA SPECIFICATIONS

	Agfa ePhoto 1680*	Nikon Coolpix 950**	Olympus D-600L***
Optical System Quality for Macrophotography (equivalent value to 35mm camera)	38-115mm Optical zoom: 3× Digital zoom: 2× (640 × 480)	38-115 mm Nikkor Zoom: 3× Digital zoom: 2.5×	36-110mm 3× zoom
Autofocus Speed and Precision	Telephoto mode: 80cm-infinity Wide-angle mode: 10cm-infinity Macro: 10cm-1m (wide-angle mode)	Autofocus TTL system + manual focus	Autofocus TTL system
CCD Resolution and Quality	Image sensor: 1.3 megapixels Resolution: 1343 × 972 (30 bit × pixel)	.5" CCD Image sensor: 2.1 megapixels Resolutions: 1600 × 1200, 1024 × 768, 640 × 480	Progressive-scan CCD 1.4 megapixels (gross) Resolutions: 1280 × 1024 and 640 × 512
Flash	Built in on side of camera	Built in on side of camera External unit connector	Built in on top of camera
Viewfinder	High-resolution 2" LCD 110,000 pixels	2" LCD 130,000 pixels	LCD back panel Resolution not indicated
Immediate Review of Recorded Images	Yes	Yes	Yes
Exposition Parameters	f/2.8 wide angle-3.5 telephoto Shutter speed 1/2-1/500 sec.	f/2.6 wide angle-4 telephoto	f/2.8
Batteries	4 AA NiMH rechargeable	4 AA batteries: NiCd, NiMH, or FR-6 lithium can be used	4 AA NiMH rechargeable (optional)
AC Connection	Optional AC adapter	Optional AC adapter	Optional AC adapter
File Formats and Software Compression	1. Very Low Compression JPEG: 1600 × 1200 2. Low Compression JPEG: 1280 × 960 or 640 × 480	1. Fine 2. Normal 3. Basic Uncompressed TIFF or Compressed JPEG	1. Standard Quality 2. High Quality 3. Super High Quality Compressed JPEG
Image Storage	4MB SSFDC SmartMedia 12-14 images (1280 x 960)	Compact flash card	4MB SmartMedia Card 4-50 images
Retail Price	$600-700	$1,000	$700-800

*Agfa Corp., 100 Challenger Road, Ridgefield Park, NJ 07660.
**Nikon, Inc., 1300 Walt Whitman Road, Melville, NY 11747.
***Olympus America, Inc., 2 Corporate Center Drive, Melville, NY 11747.

Fig. 4 A. Built-in flash on right of Agfa ePhoto 1680 creates shadows in one lateral view and both occlusal views. B. Problem can be eliminated in lateral view by rotating camera.

1600 × 1200, by interpolation. However, the photographs shown here were taken at 1280 × 960 pixels of resolution.

The digital zoom has acceptable quality, but can only be used at a resolution of 640 × 480 (Fig. 3). Autofocus speed and precision are both very good (the best in this group).

The built-in flash is on the right side of the camera, and in intraoral photography tends to produce distinct shadows in the occlusal views, the frontal view, and the left lateral mirror view (Fig. 4A). The two parts of the camera body can be rotated to overcome this problem (Fig. 4B). We also noticed that the flash light reflects on tooth surfaces.

The camera comes with four NiMH batteries, which allow 30-50 images to be shot before recharging.

Nikon Coolpix 950

The CCD quality of the Coolpix 900s (Fig. 5) was only fair, and we did not care for the picture definition (Fig. 6). The resolution of the Coolpix 950 CCD is considerably higher (2.1 megapixels, compared to 1.3 megapixels), and

Fig. 5 Nikon Coolpix 900s digital camera with external flash unit.

Fig. 6 Nikon 3× lens allows intraoral photos to be taken with 1:2 magnification ratio.

Fig. 7 Intraoral images using both external and built-in flash show good illumination in every area.

therefore the image quality should be much improved with the new model.

The ability to use an external flash synchronized with the built-in unit allows good illumination in the most difficult conditions (Fig. 7). However, the optional external flash bracket interferes with access to the memory card slot.

The autofocus speed and precision were average for this group. We do not recommend using the digital zoom, which produces a poor image quality (Fig. 8).

Fig. 8 Poor quality results from use of digital zoom instead of close-up lens.

Olympus D-600L

This model (Fig. 9) is a true "see through the lens" camera, and thus the only one tested that does not need an LCD monitor. The autofocus is the weak point of the model, because it needs a considerable amount of light to function accurately and is never very fast.

The built-in flash unit, positioned above the lenses, tends to produce shadows in the upper part of the vestibulum in front and lateral intraoral views (Fig. 10). The CCD quality is good, although we noticed a predominance of blue (Fig. 11).

Fig. 9 Olympus D-600L digital camera.

Fig. 10 Front and lateral intraoral images taken with built-in flash have shadows in upper part of vestibulum. Shadows are unobtrusive in occlusal views.

Fig. 11 A. Excessive sensitivity of CCD to blue makes this color predominant. Background of this picture, which should be black or dark gray, appears dark blue. B. Same picture after color balancing.

Discussion

Since the photo transfer from all the digital cameras to the computer is quite slow if a serial port link is used (one to two minutes for each high-resolution photo), we recommend using a PCMCIA drive and adapter, which reduce the transfer time about 90%. It is always advisable to have a spare set of rechargeable NiMH batteries and a secondary memory card if the camera is to be used routinely.

All three tested digital cameras can be used in intraoral orthodontic photography with acceptable results, but all have their strong and weak points. In our opinion, the best choice overall is the Agfa ePhoto 1680, which also has the lowest retail price. The new Nikon Coolpix 950 will probably be the best performing camera, but its price is about 50% higher than that of the Agfa ePhoto 1680.

Other digital cameras on the market, including the Olympus C2000, Sony DSC-D700, Minolta Dimage EX Zoom 1500, Ricoh RDC-4300, and Kodak DC 265, are probably also suitable for intraoral photography. Unfortunately, we did not have the opportunity to test these models. New models of digital cameras are constantly being introduced by the manufacturers, making the choice of a "best" camera difficult, if not impossible. In this article, however, we hope to have provided the reader with some useful information that will make the selection process less difficult.

REFERENCES

1. Fiorelli, G.; Pupilli, E.; and Patanè, B.: Digital photography in the orthodontic practice, J. Clin. Orthod. 32:651-656, 1998.
2. Campbell, M.A.: Digital imaging: Ortho Bytes readers comment, Am. J. Orthod. 112:580-581, 1997.
3. Coimbra, O. et al.: Digital imaging and orthodontics, Am. J. Orthod. 115:103-105, 1999.
4. Niamtu, J. III: Digital imaging: Ortho Bytes readers comment, Am. J. Orthod. 112:582-583, 1997.
5. Scholz, R.P.: Considerations in selecting a digital camera for orthodontic records, Am. J. Orthod. 114:603-605, 1998.

Editor's Note: JCO readers are invited to send us their own evaluations of digital cameras in orthodontic photography. Representative photographs are welcome. Responses may be summarized and published in an upcoming issue. Write to Editor, Journal of Clinical Orthodontics, 1828 Pearl St., Boulder, CO 80302, or email jcoedit@aol.com.