What's new in digital photography?

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Digital photography has become ubiquitous in modern society and its importance in dentistry is unquestionable.[3,4,5,9] This assertion is confirmed by the fact that the 2009 Nobel Prize in Physics was awarded to the inventors of the charge coupled device (CCD).[10]

Although this technology dates back to the 1970s and the first digital camera was launched in the market in the 1990s, the clinical use of this tool in dental offices has become a reality in the early 21st century.[5,11] CCD allows users to view photographs on the spot, eliminating film and film development costs while systematic image management can be performed in the clinic. These features have combined to make this novel digital system extremely attractive.[3,6] Another advantage lies in CCD's image manipulation and editing capabilities, which streamline interpersonal communication, ensuring successful results.[2,8] Figures 1 and 2 show examples of digital manipulation assisting in outcome prediction and clinical procedure planning, respectively.

Although historically the introduction of this resource in dental practice is a recent phenomenon, digital cameras have become commonplace in most orthodontic offices. However, increasing market pressures to sell modern cameras with higher resolutions pose some important questions: What's new in digital photography? Are the "latest" cameras that boast more and more megapixels (MP) our best choice? What's the best suited resolution for orthodontic photography?

Due to the lack of literature in this area, it might prove convenient to provide some clarification so that orthodontists can learn about the technical and scientific reasons for taking advantage, as much as possible, of the benefits of digital photography.

WHAT'S NEW IN DIGITAL PHOTOGRAPHY?

For a "recent" technology, the development of digital photography has been overwhelming. Today's professional cameras can shoot and show you the scene just photographed on a liquid crystal display, features not available prior to 2009. Another innovation are cameras that transfer data wirelessly and some can even access the Internet. It is noteworthy that since this technology is under constant development, new camera models with different features are launched in the market on a weekly basis.[7,8]

Of all technological innovations built into these new devices, manufacturers particularly emphasize resolution,[4,7] i.e., "more and more megapixels!". Currently, there are digital cameras with resolutions of up to 28MPs, enabling users to print images as large as 52 x 39 cm[1] in high resolution (300 dpi). This may be vital for photographers who are constantly working at high magnifications, but can dentists benefit from such high resolutions?

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FIGURE 1 - Example of image manipulation as a resource to assist in interpersonal communication: **A)** before, **B**) manipulated image and **C**) after restoration with resin.

FIGURE 2 - Example of image manipulation as an auxiliary resource in planning: **A)** before, **B)** study of the gingival area to be removed in periodontal plastic surgery and **C)** after the surgical outcome.

ARE THE "LATEST" CAMERAS THAT BOAST MORE AND MORE MEGAPIXELS (MP) OUR BEST CHOICE? WHAT'S THE BEST SUITED RESOLUTION FOR ORTHODONTIC PHOTOGRAPHY?

Resolution is directly related to final image quality and depends on the camera's ability to capture pixels (tiny squares that make up the image).[4,5] However, it is essential to understand that resolution, or rather, that many megapixels (MP) are not synonymous with quality.[4,7]

Let's envisage the following scenario: A friend returns from a trip abroad and tells you that she bought a digital camera. After hearing the news, what would your first question be? Probably: – How many megapixels is it? This word refers to how many million pixels the camera can record in one snapshot. Some 2004 publications showed that at that time cameras had a standard resolution of 3 to 5MP.[4,7,8] Currently, you may not be able to purchase a camera with such "low" resolution because the current standard is 10 to 15MP. So what has changed? Have these cameras turned obsolete despite such high resolution numbers? Is it necessary to upgrade these cameras to have higher resolutions? Are the newer cameras any better?

To answer these questions I should start by explaining that digital camera resolution measured in MPs—the main target of manufacturer advertising—is much more related to maximum printing size than image quality *per se*.[4] In orthodontics, most tasks involve viewing digital photos on computers and multimedia projectors and printing them with conventional equipment, specialized laboratories and scientific articles.[2,4]

Accordingly, 3 to 5MP quality photographs would be enough to meet all these needs. For example, if two images are displayed side by side on a computer screen or multimedia projector, one with 1MP and one with 10MP resolution, they will exhibit the same quality. To give a practical example, figure 3 has 4 images, with 10, 8, 5 and 3MP and were developed in the same size on paper and using the same system. Which one has better quality? There is no difference! In fact, they have different MPs. However, when they are printed on paper they will appear in the same 300 dpi (dots per inch) resolution. The moral of the story is that: "Size does not matter", or rather, resolution is not synonymous with quality.

This can be very confusing, even for the scientific community. Some journals mistakenly require in their information for authors that digital images be submitted from maximum resolution digital cameras. Others specify values like "a minimum of 8MP". Unfortunately, this is a huge mistake because the default resolution standard for print images should be given in dpi, not MP. As an example of appropriate characterization of these images, Dental Press Journal requires 300 dpi images, which can have 3, 5, 7, 10, 15 or more MPs. However, when printed on paper, all will now have 300 dots per inch.

To simplify this concept we can use the following analogy.[4] Picture yourself in a car in a bumper-to-bumper traffic jam. The maximum speed feasible at this time is 20 mph but you are driving a vehicle that can reach a top speed of 160 mph (a Ferrari, for example). What is the advantage of such potential staggering speed in these circumstances? None other than the fact that you're driving a Ferrari, of course! Unfortunately, despite the car's speed capabilities you cannot use this feature at this time. The same applies to image resolution. A 10MP photograph has thousands of pixels but just as the car cannot exceed 20 mph the image will not show 10 million pixels but only the maximum computer screen resolution, which varies between 1 and 2MP. On the other hand, just as a car can reach higher speeds on a racetrack you can use higher resolutions in other situations.

In such cases, if you own a 12MP camera for example, you can cut up an image into small pieces and magnify them while still maintaining its original high quality. It should be underscored, however, that high resolution photos may seem "heavy" or "slow", hindering computer performance, especially during multimedia presentations.[4] For example, the image shown in Figure 3D is eight times smaller (in bytes) than 3A, although both exhibit the same standard of quality.

The ideal would be to use images with a good quality/file size ratio.[4] To do this, I suggest the purchase of a digital camera compatible with the current standard market, typically featuring 10 to 15MP. However, the device should be adjusted to work at lower resolutions (5MP, for example) to meet the needs of routine orthodontic practice with a high standard of quality. In some specific situations, such as when you need to develop larger sized photos, e.g., a poster or banner, the camera can be once again adjusted to take higher resolution pictures.

What about the question posed earlier? Have "older", lower resolution devices been rendered obsolete in view of the resolution power of "recent" DSLR cameras? Technically and scientifically, the answer is no. The analysis shown in Figure 3 demonstrates the high applicability of resolutions lower than the current 10 to 15MP standard, provided that they conform with the 300 dpi specification.

The truth of the matter is that manufacturers need to sell their products. In their view, it is convenient to create a number system whereby consumers are led to believe that "the higher the number the better the quality", and just keep on buying.

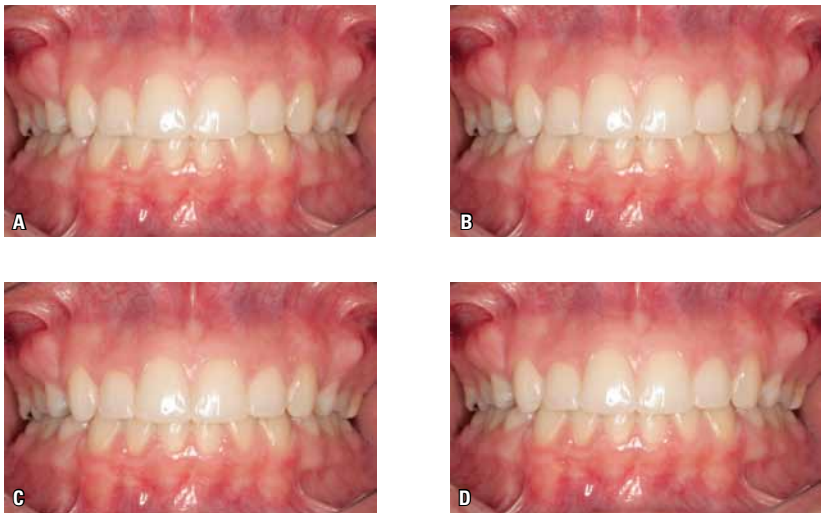

FIGURE 3 - Example of using the same image with different resolutions and therefore different file sizes: **A)** 10 MP (3,869 Kbytes), **B)** 8 MP (3,239 Kbytes), **C)** 5 MP (667 Kbytes) e **D)** 3 MP (483 Kbytes).

FINAL CONSIDERATIONS

"Novelty" is an essential component of society's evolution. Nevertheless, it is important to remember that behind any "novelty" the ultimate goal is not always "to make something better" or "to improve the quality of something". The major goal, more often than not, is profit. In digital photography, companies are not concerned with the needs of orthodontists when they launch new digital cameras. Their actual focus is on photographers, whose market is always hungry for innovations. The 21st century orthodontist should possess not only scientific and technical knowledge but also the insight to discern when "novelty" is likely to bring tangible benefits.

On a final note, here is my appeal to the readers: Go on taking photos! Take full advantage of these resources! They will surely prove invaluable!

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