Computer Imaging: True or False

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Technologic advancements in the field of computer imaging are providing plastic surgeons with the ability to give patients a visual forecast of postsurgical outcome and serve as a platform for improved doctor-patient communication. This same technology allows the convenient and stable storage, cataloguing and rapid retrieval of massive numbers of photographs in minimal space. Along with these positive aspects, negative ones are becoming apparent. Poor prediction of outcomes by the physician, whether conscious or not, could result in patient dissatisfaction with what might be an optimal operative result. The hard copy evidence of the predicted outcome may then serve as evidence in our very unyielding legal system. Our inability to discern altered from unaltered photographs, negatives and slides presents our profession with ethical challenges in the presentation of data to our peers. Some partial solutions are discussed but the advent of this new technology calls us to a unique and absolute commitment to professional honesty.

Introduction

We are bombarded daily with the products of professional photography that have been digitized, altered and retouched to form striking images. Medical photography has long been the staple of record keeping and conveyance of techniques and results to our peers. As plastic surgeons, perhaps more than other medical specialties, we select and modify our procedures based on published and presented photographic records. This is natural for such a visual specialty. We have availed ourselves of the new technologies of photography and computer imaging for all of their positive aspects. We now realize there could be some drawbacks to what these technologies allow us.

The Technology

The rapid march of technology has revolutionized medical photography. We can presently photograph (or *image* a patient, in the new jargon meaning to photograph in such a way that a computer can understand the picture) with the resolution of the best quality cameras of old. Indeed if a negative or slide format is used, the resultant photograph can be used and scanned into a computer for digitization of the image. Both Figures 1 and 2 in this paper were produced in such a manner. They were scanned (meaning to read a photograph or document by a computer) with a high quality VHS camera. Much higher resolution can be afforded by scanning with a flatbed scanner of 1600 dpi (dots per inch) resolution or, even better, scanning negatives or slides into the computer by way of a film scanner (capable of 3072 x 2048 pixel resolution—equivalent to 2000 dpi or that afforded by high quality photographic film). The direct digital transfer of images into the computer can attain even higher resolutions when there is no analog media intervening. Even with the limited resolution of the technique available to us, very little difference can be discerned between the original photograph and that generated by the computer, other than a slight, generalized *blurring* of the image. Current high resolution pictures stored by the Kodak™ system allow only 100 photographs per compact disc (CD); however, data compression allows much higher storage capabilities and current computer-imaging compression (with slightly less resolution) allows for 10,000 images to be stored on a gigabyte drive—the storage space equivalent to a CD. The output for the *hard copy* of the image—that which we can see—can be on any format depending on the type of black box that is affixed to the output end of the computer. Slides and negatives can be easily generated, and from them, classic photographs, or, if desired, photographs of equal resolution and stability can be generated directly onto special paper and a high-resolution, color photograph produced immediately without the need for photo processing or the storage of slides and negatives. Computer images are stable indefinitely and simple backup of files eliminates the possibility of loss. Storage of the backup files should be away from the computer and the office; many physicians store the backup files at home. This technology is decreasing in price daily and will soon be the standard manner of stable, safe and economical storage of images.

Computer imaging is somewhat different from the above outline of state-of-the-art medical photography. Computer imaging uses the above technology but then the image is altered. This can be likened to original writing and typing of documents that has since been revolutionized with the advent of word-processing technology. We now can change images as readily as we can change words. Modern software allows an almost limitless array of abilities in this area from simply changing silhouettes, backgrounds and textures to automatically erasing shadows and filling in the altered area with identical color and texture foreground when a change in contour has been made. The contour edge, similarly, is automatically matched to its adjacent edge yielding an imperceptibly altered outline. The ease of these procedures is truly phenomenal. Image changes are now almost instantaneous.

Positive Aspects

Perhaps most important, particularly in the field of plastic surgery, computer-imaging technology allows the ethical surgeon an easel as a platform for the examination and discussion of what is most desirable aesthetically. This can be expanded to other specialties by allowing a platform for the discussion of surgical procedures and medical events. We can exploit this technology to improve physician–patient communication and facilitate understanding by patients of their condition, medical and surgical interventions. This means of communication often serves to crystallize patients' wishes and is a way of outlining surgical possibilities in our field. Immediate images and alterations are possible to facilitate this.

The efficient storage and ready retrieval of images coupled with the ability to catalogue them and compile them under groupings other than by patient name or identification number allow us to critically look at surgical results as compared to predictions. This previously took many years of intensive and critical review of photographs of

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patients; now the process is abbreviated and streamlined and allows us to look at groups of similar patients quickly and easily to see if our procedures measure up to our expectations. The selective memory that we often possess regarding good and poor surgical outcomes in recalling the last 5 cases, or the best or the worst result, can be aided by such imaging. The subconscious bias in our care of patients may indeed be alleviated as we are confronted regularly and readily with the surgical results. We can then be able to predict outcomes more accurately as sequelae of our surgical actions and rely less on memory alone to determine future surgical procedures and techniques.

Additionally, this way will be used by many surgeons because of its convenience, stability, safety and efficiency. Lost photographs will be a thing of the past.

The ability to rely on an *in-house* system allows for greater retrieval of images as well as of hard-copy photographs. It not only saves a great deal of money following the initial investment, but makes available images for review pre-, intra- or post-operatively. The photographs can be cross-referenced in patients' charts; if the latter are digitized, the 2 can be readily integrated. The quality of the images can be regulated readily and the ability to digitally overlap images allows for exactly the same patient attitude, angulation and lighting in pre- and post-operative images—as well as in between patients—a perennial problem in medical photography.[1]

Figure 1: Computer-generated image of a true post-operative result (*Left*) and a computer-generated image with no basis in truth (*Right*). The patient had a tertiary rhinoplasty and the projection of her nasal tip. Although it was the best achievable for her, it was suboptimal. She is very pleased with her operative result, as it is a great improvement over her condition pre-operatively; however, would she be as pleased if the image on the right had been predicted erroneously pre-operatively?

Negative Aspects

Dishonesty or at the very least poor prediction of operative outcome is the most overt of the bad aspects of computer-imaging technology. Misrepresentation of what can be done, delineating impossible surgical outcomes is obviously unprofessional and unethical (see Fig. 1). The use of computer imaging as a sales or marketing tool is mentioned only to be condemned. Flagrant misrepresentation to patients will only debase our profession.

Less obvious is the fact that patients could mistake facility with the computer for surgical expertise. The ability to alter images on a computer obviously is no indication of the ability to alter form or function in the operating room.

The hard copy of predicted surgical outcome given to patients could serve as a platform for lawsuits despite appropriate disclaimers. The fact that hard evidence of what was promised preoperatively does exist might help us, again, to analyze critically our procedures and methods.

Unfortunately, healing characteristics of individuals and unforeseen complications leading to subsequent poor or altered outcomes are predictable. In the present legal climate, a promised result, particularly with detailed evidence to support it, will not be able to be upheld against a poor or altered outcome. More so, an overly optimistic prediction of surgical outcome, despite perhaps an optimal result for that patient may lead to dissatisfaction with what might otherwise be an acceptable outcome.

Some users of computer imaging do not give patients a hard copy of the predicted outcome. Whether this is in the patient's possession, or in his or her memory, we must be as honest as possible with both our patients and ourselves.

Figure 2: (Above Left) Unaltered, pre-operative photograph of the patient; notice the right upper lid ptosis. (*Above, Right*) The original, unaltered, post-operative photograph of the same patient. Ptosis correction, upper lid blepharoplasty and lower lid shortening procedure was performed. (*Below, Left*) The computer-generated photograph of proposed operative correction. Note that this photograph is almost identical to the true post-operative photograph. (*Below, Right*) Another computer-generated photograph of the patient taken from the true post-operative photograph with correction of the mild ectropion. This photograph has no basis in truth.

Minor negative aspects of this technology are its present cost. Sophisticated systems complete with software cost about $25,000 to $30,000. This cost must be absorbed by the office and will ultimately be passed on to our patients. Some practitioners charge for imaging although, in time, it will likely integrate into our practices. Costs decrease almost daily, particularly for the computer hardware.

Loss of data is easily circumvented by regular use of backup and the use of read-only formats. In the latter category are CDs that require special equipment to boot up. There are WORM (write once, read many) drives that can be used. Optical drives allow the ready and relatively inexpensive storage of large amounts of data and are often the preferred current day format of computer imagers.

Perhaps the most serious repercussion of this new technology is the reality that no published or otherwise presented image need be based on fact. More than in any other discipline, plastic surgeons select and modify procedures based on published and presented photographic records. This is natural for such a visual specialty and it is also natural that we try to present our work in the best possible light; this occasionally leads to unintentional (or intentional) misrepresentation. Until recently such misrepresentation could be accomplished by such benign methods as altering the light source and the intensity of lighting, altering posture and position, altering appearance with makeup or varying hairstyles, and changing camera focus and focal length as well as distance to the subject. Fortunately, there are clues to these classic distortions making them evident to an astute critical analysis of the photographs.[1]

Today this is no longer the case. We now have the ability to modify readily our results in every way imaginable (see Figs. 1 and 2). There is no requirement for an original photograph before and after surgery; any image is alterable. When we convert to images that are computer-generated for both pre- and post-operative images, we lose our fixed point of reference. This loss does not allow any way of ascertaining the

authenticity of the photographs or images of the patients. Indeed, at the present time, there is no guarantee of authenticity of any before or after surgical photograph presented by any media.

There may be ways of discerning digitally altered images by inconsistent shadows or minute inconsistencies in outline but, practically speaking, with the resolution offered by the software available today, such detection is impossible. We have already mentioned that submission of negatives and slides is no help in ascertaining authenticity since they can be computer-generated readily. The user-unalterable nature of CD technology may be of some help in that images could be submitted to a licensed and bonded agent for transfer to these disks. There is still the lag between hard disk, diskette or tape storage and CD transfer where images are imminently alterable by the user. Developers of computer imaging software have anticipated the possible problems with authenticity and one company(Mirror Image Technology, Lynnwood, Wash.) has incorporated a pixel counter into its software. This prints an original symbol on an image read into the computer and any alteration of it leads to a different pixel count and subsequent erasure of the symbol. This is a thoughtful step on the part of the imaging industry; however, it is likely to be easy to alter the computer code generating the seal. It will furthermore prove useless unless the seal is required on all photographs submitted for publication and that would be possible only if all authors have identical software and imaging systems, an unlikely prospect.

Conclusion

Digitized medical photography and computer-imaging have many positive and negative aspects associated with their use. The advent of this new technology calls us to make a unique and absolute commitment to professional honesty on many levels. If we fail to rise to this high calling, we will cease to be led by those with skill, creativity, insight and experience into using the best and most effective procedures. Instead, we will find ourselves following those with the greatest computer proficiency and the lowest levels of professional ethics. Affidavits regarding authenticity and oaths as to photographic honesty offer assurance, but unless we are absolute in our commitment to truth, our profession will be up for grabs.

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Reference

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