Original Article

Can the Rapidly Evolving Digital Technology be Employed in the Surgical Pathology Lab? The Shifting Paradigm

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Objective: To evaluate and compare the efficacy of four devices for digital photographing of gross specimens in Surgical Pathology lab. To assess the usefulness of magnifying apps, currently available for mobile phones, in studying details of pathological specimens during their gross examination.

Material and Methods: This comparative study was carried out from Nov. 2012 to Dec. 2012 Fifty specimens were photographed; some of these were received in Department of Pathology, Postgraduate Medical Institute, Lahore, while others were from some private laboratories. Non probability purposive sampling was used to include cases which were likely to reveal interesting and comparable details. Four different devices namely Nikon Coolpix S-80, Apple iPhone 4, Samsung Galaxy S Duos and Samsung Galaxy Note II loaded with "Magnify" app were used. Results were compared subjectively regarding image resolution, sharpness, color accuracy, tone reproduction, contrast, signal to noise ratio and overall usefulness. Nikon Coolpix S-80 served as the reference index against which the other devices were assessed.

Results: All devices gave photographs of quality good enough to be used for scientific purposes. iPhone occasionally surpassed Nikon in spite of its far more humble megapixel "score". Samsung Galaxy Note II with "Magnify" app revealed details that could render the conventional dissecting microscopes obsolete. These findings are supported by other reports comparing different devices, though none of these refers to photographing of pathological specimens.

Conclusion: In view of the widespread availability of digital cameras since their incorporation into cell phones, it has become very feasible to photograph every specimen received in the Surgical Pathology lab. Digital photography has removed, to a substantial extent, the constraints of time, cost, labor and expertise involved in photographing. In conclusion, the causes for conversion to this commandeering, contemporary technique are compelling, convincing and countless.

Key words: Digital imaging, megapixels, specimen photography, dissecting microscope.

Introduction

Pathology has been aptly described as a visual science and this applies to no other branch of Pathology better than Surgical Pathology, being dependent as it is, on imagery for both its gross and microscopic stages.[1] In fact, all the aspects of Surgical Pathology like diagnosis, consultation, education and documentation are critically dependent on morphological findings. Hence, it is not surprising that advances in digital imaging in the last two decades have made major inroads into the routine practice of Surgical Pathology. We are now talking about innovations like telepathology/telemicroscopy, Whole Slide Imaging for archiving and perhaps machine analysis systems that would allow Pathology to become a more "quantitative" science by the introduction of computerized mitotic counts, cytomorphometry and even densitometry.[2,3]

Digital imaging has revolutionized the way we handle images. It offers the advantages of instant gratification (circumventing the time lost in waiting for the prints to arrive in previous systems), almost no running costs, the option of endless copies to be made, and the ease of incorporation into texts, publications, lectures and conference papers. Images are amenable to "photo-shopping" by amateurs greatly enhancing image quality and highlighting areas of interest. And of course they are "backward compatible"; you can always have the more precious ones printed if like me you don't sleep easy unless you have a hard copy resting in your drawer.[4,5] Digital cameras were well received being user friendly as well as cost effective and have gradually replaced the older versions all around the world. Numerous papers were written in the last two decades offering advice on the best camera for use in Pathology lab and how best to use it.[2,4] Parallel to this proliferation of digital cameras

small hand held devices soon created a niche in our lives to the extent that today we feel as if they are an extension of our selves. These quickly evolved to become more and more capable and the advent of "smartphones" has seen the incorporation of better and better cameras into these amazing devices. The opening of the Apple App Store, then the Google Play Store and now the Windows Store has brought endless opportunities. Thousands of free as well as paid "apps" are available to enhance the functioning of our mobile devices in any direction that we choose. The ability to magnify images is one of these options. Several "apps" like "Magnify", "Your Magnifying Glass" and "Smart Magnifier" are available for free while some like "Your Magnifier Pro" and "Magnify (Ad-Free)" can be downloaded on payment from the Google Play Store.[3] This study was done with a view to explore the wonders of digital photography as they apply to imaging of gross specimens in a Surgical Pathology lab.

Materials and Methods

Fifty specimens were chosen for gross/macroscopic photography. Some of these were received in the Department of Pathology, Postgraduate Medical Institute, Lahore, while others were from some private laboratories. Non probability purposive sampling was used to include cases which were likely to reveal interesting and comparable details. The period of study was from 1.11.2012 to 31.12.2012. The breakdown of specimen types is given in the Table. A mid-range camera Nikon Coolpix S-80 was used as the Reference Index. It served as the yard stick against which the performance of other devices was measured. It is a 14 megapixel camera of the "point and shoot" type. Cameras far simpler than this one have been declared adequate for photographing Surgical Pathology specimens in earlier reports.[2] The macro mode was selected for photographing the specimens. Images taken by this camera were compared subjectively with those taken by two popular cell phone models. The details of these are as follows:

i) Apple iPhone 4 running on iOS 5.Camera 5 megapixel.
ii) Samsung Galaxy S Duos S-7562 running on Android OS (Ice Cream Sandwich) Camera 5 megapixel

In addition, magnified images were taken to assess their utility in

i) Adding to assessment of nature of lesion
ii) Assistance in selection of area to be submitted for blocking

For this purpose the following device was used:
Samsung Galaxy Note II N-7100 running on Android OS 4.1.1 (Jelly Beans) Camera 8 megapixel with "Magnify" app, free to download from the Google Play Store.
Each specimen was photographed with each of these devices. The following precautions were taken during photography:

i) The photos were taken under similar conditions of illumination (even the schedule of load shedding was taken into consideration)
ii) The background was identical throughout.
iii) No image processing or color balancing was done for any photo.
iv) A minimum distance of 10 cm was maintained between the specimen and the device as this was suggested by most devices' Users Manuals.

The images were regularly transferred to a laptop for proper archiving. They were arranged into the following groups:
Group A: Images taken by Nikon Coolpix S-80
Group B: Images taken by Apple iPhone 4
Group C: Images taken by Samsung Galaxy S Duos S-7562
Group D: Images taken by Samsung Galaxy Note II N-7100 with "Magnify" app
The results of Groups A-C were compared regarding image resolution, sharpness, color accuracy, tone

Table-1: The details of the specimens included in the study.

Type of Specimen	Number
Total abdominal hysterectomy	07
Gallbaladder	06
Appendix	06
Fibroadenoma	05
Leiomyoma	04
Invasive ductal carcinoma breast	03
Fallopian ectopic pregnancy	03
Kidney	03
Intestine	03
Transurethral resection prostate	03
Osteochondroma	02
Gynaecomastia	02
Low-grade endometrial stromal sarcoma	01
Fetus	01
Diagnostic D&C	01
Total	50

Results

Some of the results are shown in Fig 1-3. Group A showed satisfactory results in terms of image resolution, sharpness, color accuracy, tone reproduction, contrast, signal to noise ratio and overall usefulness **(Fig 1, 2).**
Group B gave results which were as good as and

reproduction, contrast, signal to noise ratio and overall usefulness. The results of Group D gave information of a different nature so they were assessed independently. especially excelled in sharpness and color accuracy. Group C lagged behind, though only slightly, in image resolution, sharpness and color accuracy. In absolute terms, results in this group too were good enough to be used for scientific purposes **(Fig 2).** Group D was a class on its own. The details revealed due to magnification were helpful in most cases and enlightening in some. Features like resolution, sharpness and signal to noise ratio were well maintained, though there was a slight fall in color accuracy as well as tone reproduction. The images were especially useful in selection of area to be submitted for blocking. These details also shed light on the nature of lesion as being myxomatous, hyaline, caseous etc., far better than the naked eye examination alone. For example, in cases of Invasive ductal carcinoma breast permeation of tumor into

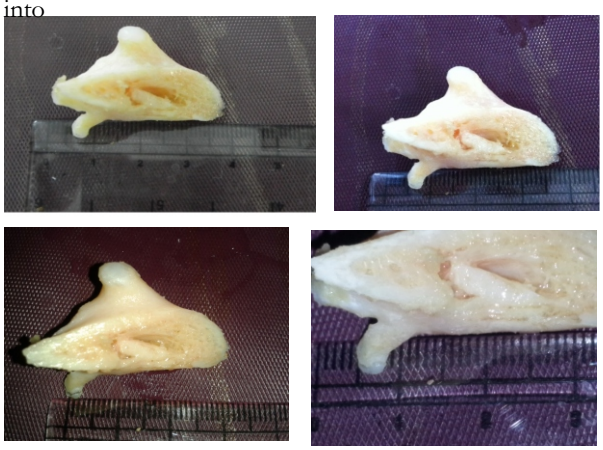

Fig-1: Photographs of an osteochondroma taken by different devices. 1B (taken by iPhone 4) gives good details while 1D (taken by Samsung Galaxy Note II) differentiates the layers apart.

Fig-2: Photographs of a Low-grade Endometrial Stromal Sarcoma. All devices gave satisfactory morphology with additional details being furnished in Group D.

the surrounding tissue could be easily discerned. Another specimen that greatly benefited from this examination was a fetus whose gender determination as well as counting of digits was rendered possible (Fig 3). Specimens like Fallopian ectopic pregnancies also revealed interesting details. Similarly, the whorling and hyaline degeneration of leiomyomas was well shown up. As shown in Fig 1 different layers of osteochondromas could also be discriminated. Similarly, Fig 2 shows almost equivalent performance by the three devices and highlighting of minute details in a case of Low-grade Endometrial Stromal Sarcoma in

Fig-3: Samsung Galaxy Note II with "Magnify" app enabled one to study the toes and genitilia of a fetus; otherwise impossible with the naked eye.

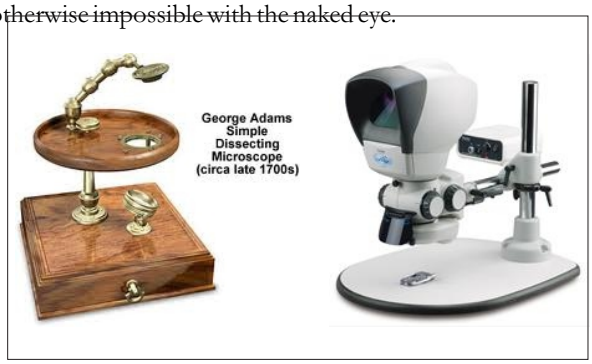

Fig 4: The dissecting microscope has evolved over time and as can be seen above has come a long way.

Discussion

Digital photography has created a new paradigm in which Surgical Pathology is likely to be practiced from now on.[3,6] So far we have depended upon the process of descriptive prose with inevitable variation in expression, vocabulary and style of the person responsible, and these are often considerable. Adoption of digital photography can document the true appearance of the specimen and eliminate much

idea and has been practiced for a long time.[7,8] But considerations of cost, time, ease and expertise have prevented it from becoming a norm. Adoption of digital photography of gross specimens as a routine would allow us to incorporate these photos into pathology reports as well as have a better archival record. Details of sections submitted could be indicated on these photos.[9] This could dramatically alter the face and format of future pathology reports which could consequently become more accurate and succinct.[4,10]

Though many of us would agree with the idea in theory, they might find the idea of carrying a camera around all the time too cumbersome. So it was thought that the small devices most of us carried in our pockets or bags should be given a try. The results were encouraging.

iPhone 4 gave very high quality images. Most of results were as good as Canon Coolpix S-80, while some were even superior **(Fig 1,2).** This appears paradoxical since iPhone 4 comes with a 5 megapixel camera while the latter boasts of a 14 megapixel one. This can be explained by the fact that the megapixel "score" is only one of the factors determining the quality of image taken.[11] The lens and the camera's image processing capability are also important. Literature abounds with warnings about an over-fascination with megapixels. iPhone is claimed to be loaded with better processors etc. Our results upheld this claim.[2,11,12] Samsung Galaxy S Duos gave images which were only slightly less in quality than those of the other two. The color detail and sharpness was less but even these images were good enough to be used for scientific purposes **(Fig 1,2).**

Samsung Galaxy Note II loaded with "Magnify" app proved to be a tool no pathologist should be ignorant of. It shed light on a lot of specimens already listed (Fig 1-3). In fact, it may perhaps render the dissecting microscope obsolete. These microscopes have long been employed in Surgical Pathology labs to study the gross features of specimens in detail and to select areas to be submitted for microscopic examination (Fig 4). Now, both these purposes may be served by a compact smartphone.[13,14]

In addition, 3-D images of selected cases may be generated for teaching purposes, which may in future prove to be an alternative to our current practice of storing actual specimens in museums. Such novel archives would be practically maintenance free, and would require minimal physical space for storage. They would not be subject to legalities of organ retention and amenable to endless copying.[2,4]

Conclusion

In view of the widespread availability of digital cameras since their incorporation into cell phones, it has become very feasible to photograph every specimen received in the Surgical Pathology lab. Digital photography has removed, to a substantial extent, the constraints of time, cost, labor and expertise hitherto involved in photographing. In conclusion, the causes for conversion to this commandeering, contemporary technique are compelling, convincing and countless.

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Medical News

EMERGENCY ALLERGY NEEDLES TOO SHORT FOR HEAVY PEOPLE?

People with serious allergies who are obese may find out in a moment of crisis their epinephrine injection needles aren't long enough to be effective, according to a new study.

"Epinephrine works best when injected into the muscle," lead author Dr. Mary Colleen Bhalla said. "When it is injected into the fat layer of the skin it takes longer to reach the blood stream."

"When a person is having a severe allergic reaction they need the medicine to work as soon as possible," she told Reuters Health. In an allergy attack, airways constrict and may make breathing impossible. While waiting for emergency responders to arrive on the scene, the victim or a friend may use an autoinjector to deliver epinephrine, or adrenaline - a hormone that constricts blood vessels and relaxes airway muscles - into the thigh. If the injector needle is not long enough to reach muscle tissue, the extra time the drugs take to get into the bloodstream could be the difference between life and death for people with severe allergic reactions, Bhalla, of the Summa Akron City Hospital in Ohio, said. "A bee sting can cause death in 15 minutes," she said. "One study found that the epinephrine got in the bloodstream in an average of 8 minutes when given in the muscle, but an average of 34 minutes when given in the fat layer of the skin."

In an indirect investigation of the problem, Bhalla's team decided to measure the thickness of fat around the thighs of a random sample of patients in an emergency room and compare the measurements to the length of the longest available needle. At the time, the longest needle available was about 16 millimeters, or about two-thirds of an inch. Of 120 emergency room patients, 31 percent had layers of fat thicker than 16 millimeters around the thigh, the usual epinephrine needle injection point. Five percent of men and 54 percent of women in the sample fell into this category, according to the researchers' report in the American Journal of Emergency Medicine.

More than half of the people studied were obese. The results are still hypothetical, since the researchers didn't go as far as trying the injectors on people having allergy attacks to see if they would be effective.

An injector with a 25 millimeter needle - about an inch - has been approved and will be available in late 2013 in the UK, Germany and Sweden, which would help solve the problem in the U.S., Bhalla said.

"In our study we found that we would need a needle length of 18mm to get the drug in the muscle in 95 percent of men, however we found that we would need a needle length of 35mm to get the drug in the muscle of 95 percent of women," she said.

But 35 millimeter needles would hit bone for some people and could be dangerous. A wider variety of needle sizes or an autoinjector that automatically adjusts needle length on insertion might be the best solution, she said. Patients should always keep their injector close and use it s soon as they realize they have been exposed to an allergen, and call emergency medical services as soon as possible, she said. Professionals have better ways of delivering the necessary drugs. "This study and several others suggest that the needle length of the autoinjectors may be too short to reach muscle in people with more body fat in the leg," Dr. Scott Sicherer said. "This is an important concern." Sicherer is a professor of pediatrics and a researcher at the Jaffe Food Allergy Institute at Mount Sinai in New York, and was not involved in the study. "Since the injectors forcefully spray the medicine beyond the tip of the needle, and there are insufficient direct studies of how the medications behave in people of different body sizes, the studies like this one looking simply at the anatomy of the leg have practical limitations," he said. "However, an important question is being raised that warrants more study." (This story has been refilled to change headline to remove reference to brand-name device.)