Gigapixel Photography for Skin Cancer Surveillance: A Novel Alternative to Total-Body Photography

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Practice Points

- Use of total-body photography detects melanoma earlier in high-risk patients.
- Gigapixel photography is a cutting-edge technology that has tremendous potential to revolutionize cutaneous imaging and further skin cancer screening efforts.

There is substantial evidence supporting the use of cutaneous imaging in combination with standard total-body skin examinations for early detection and treatment of melanoma. In the last 2 decades, total-body photography (TBP) has been widely used in combination with standard total-body skin examinations for active skin cancer surveillance with proven clinical utility; however, the groundbreaking image detail provided by gigapixel photography (GP) could improve dermatologists' ability to monitor suspicious lesions and therefore could serve a critical role in supplementing traditional total-body skin examinations for skin cancer surveillance. Although it has been successfully implemented in other fields, future studies are required to determine the effectiveness of GP in dermatology.

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Although melanoma accounts for only 4% of all skin cancers, it is the leading cause of cancer-related deaths in women aged 25 to 30 years and the most common form of cancer in adults aged 25 to 29 years.[1] As with all types of cancer, early diagnosis and prompt treatment of melanoma can improve the patient's prognosis. Active surveillance of patients at high risk for developing melanoma is critical to early detection and better prognosis. The clinical utility of total-body photography (TBP) for active melanoma surveillance has been well demonstrated when used in combination with standard total-body skin examinations.[2] The present article introduces gigapixel photography (GP), a cutting-edge technology that could supplant TBP as the preferred modality of total-body imaging for skin cancer surveillance.

Skin Cancer Screening and Surveillance

Studies have shown that regular skin cancer screening and surveillance can improve outcomes in melanoma patients. Richert et al[3] found that high-risk patients who underwent regular skin examinations were diagnosed with substantially thinner melanomas compared to patients in a nonsurveillance group, an outcome that is directly related to mortality benefit in the intervention group. In a landmark prospective study from Germany, routine total-body skin examinations led to a nearly 50% reduction in melanoma mortality over a 5-year period; as a result, skin cancer screening was adopted as part of Germany's statutory health insurance in 2008.[4] Furthermore, multiple evaluation of TBP in conjunction with total-body skin examinations for melanoma screening found decreased rates of biopsy and increased rates of melanoma detection.[2,5-7]

Total-Body Photography

Total-body photography is the most widely studied and the oldest technology used in augmenting skin cancer surveillance for high-risk patients. A TBP

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imaging session requires at least 20 still photographs by a professional photographer to successfully capture most of the body surface area.[8] Photographers typically use digital single-lens reflex cameras that can capture images up to 20 to 30 megapixels. The TBP software typically is expensive, proprietary, and developed by small vendors. Although cutaneous imaging has been used in dermatology for the last 2 decades, there has been minimal technological innovation, with only linear increases in camera resolution.

Survey data from 83 attending physicians in US dermatology training programs showed that 71.1% (59/83) of respondents used TBP at their respective academic centers.[7] Due to the widely observed clinical benefits of TBP, the American Medical Association recently created a *Current Procedural Terminology* code (96904) for use of TBP in patients with dysplastic nevi.[9] In 2010, Goodson et al[10] published a study comparing TBP and digital epiluminescence microscopy (DELM) photography, also known as dermatoscopy. They reported that patients who underwent TBP imaging required fewer biopsies compared to the DELM group (0.59 vs 1.1 per patient) and TBP yielded superior melanoma detection rates compared to DELM (5.5% vs 2.2%). Furthermore, a greater proportion of melanomas were classified as in situ in the TBP group compared to the DELM group (7/12 vs 2/6). The authors attributed the superior melanoma detection with TBP to its ability to find de novo melanomas, whereas DELM only monitors preexisting suspicious nevi. However, they reported TBP required approximately 27 photographs and that the resolution may limit its ability to detect changing lesions.[10]

Gigapixel Photography

When it was first introduced, GP was used to capture high-resolution panoramas of landscapes. More recently, the fields of pathology and forensic science have adopted this technology, and it even has been used to digitize museum artwork to be viewed online. Recent developments in GP hardware have led to the production of consumer-ready devices. The technology has primarily been developed and supported by GigaPan, a commercial spin-off from successful teams at Carnegie Mellon University and the National Aeronautics and Space Administration.[11]

The biggest attraction of GP is its 1 billion pixel resolution capacity (>1000 times higher than TBP), which offers unparalleled image detail[11]; to date, however, GP has not been evaluated for use in a dermatologic setting. A single photograph of the entire anterior body (Figure 1) has a resolution high enough to allow physicians to zoom in on individual lesions with sufficient detail to monitor suspicious changes all over the body (Figure 2).[12] Because of the panoramic capacity of GP devices, only 1 or 2 photographs could be needed to capture the entire anterior surface of the patient's body. With the incredible postcapture pan and zoom capabilities of GP technology, individual lesion-specific photographs would no longer be necessary. Ultimately, GP could allow for substantially faster total-body imaging, remove the need for professionally trained photographers, and provide exponentially better image resolution.

Figure 1. Gigapixel photograph of the anterior body generated using the Gigapixel Micro Imager (GigaPan Systems). Reprinted with permission from Zepedro Russo.[12]

Comment

Unlike TBP, which is dermatology-specific technology, GP currently is used in a variety of industries; therefore, hardware, software, and end-to-end infrastructure for image capture and processing already exist and are available at much lower costs than TBP. With some customization of existing applications, current GP technology is available for immediate implementation in dermatology practices. Areas that will require additional software development include Health Insurance Portability and Accountability Act certification of data storage, electronic medical record interoperability, and a health care–friendly user interface. The groundbreaking image detail provided by GP could improve the dermatologist's ability to discern suspicious lesions and therefore could serve a

Figure 2. Individual lesions from the gigapixel photograph provide intricate detail of the right side of the chest (A), left leg (B), right hand (C), and left side of the chest (D). Reprinted with permission from Zepedro Russo.[12]

critical role in supplementing traditional total-body skin examinations for skin cancer surveillance.

Conclusion

Skin cancer surveillance with TBP in high-risk patients has been shown to detect melanoma at earlier stages when compared to surveillance without TBP.[2,5,6] We present a novel and cutting-edge technology that has remarkable potential to propel the field of cutaneous imaging and perhaps lead to superior clinical outcomes for skin cancer screening. Future studies are needed to observe the use of GP in a dermatologic setting.

REFERENCES

1. Herzog C, Pappo A, Bondy M, et al. Malignant melanoma. In: Bleyer A, O'Leary M, Barr R, et al, eds. *Cancer Epidemiology in Older Adolescents and Young Adults 15 to 29 Years of Age, Including SEER Incidence and Survival: 1975-2000*. Bethesda, MD: National Cancer Institute; 2006:53-64. NIH publication 06-5767.
2. Feit NE, Dusza SW, Marghoob AA. Melanomas detected with the aid of total cutaneous photography. *Br J Dermatol*. 2004;150:706-714.
3. Richert SM, D'Amico F, Rhodes AR. Cutaneous melanoma: patient surveillance and tumor progression. *J Am Acad Dermatol*. 1998;39(4, pt 1):571-577.
4. Breitbart EW, Waldmann A, Nolte S, et al. Systematic skin cancer screening in Northern Germany [published online ahead of print November 8, 2011]. *J Am Acad Dermatol*. 2012;66:201-211.
5. Kelly JW, Yeatman JM, Regalia C, et al. A high incidence of melanoma found in patients with multiple dysplastic naevi by photographic surveillance. *Med J Aust*. 1997;167:191-194.
6. Kittler H, Binder M. Risks and benefits of sequential imaging of melanocytic skin lesions in patients with multiple atypical nevi. *Arch Dermatol*. 2001;137:1590-1595.
7. Terushkin V, Oliveria SA, Marghoob AA, et al. Use of and beliefs about total body photography and dermatoscopy among US dermatology training programs: an update [published online ahead of print March 12, 2010]. *J Am Acad Dermatol*. 2010;62:794-803.
8. Wang SQ, Hashemi P. Noninvasive imaging technologies in the diagnosis of melanoma. *Semin Cutan Med Surg*. 2010;29:174-184.
9. Beebe M, Dalton JA, Espronceda M, et al. *CPT 2007 Professional Edition*. Chicago, IL: American Medical Association; 2006.
10. Goodson AG, Florell SR, Hyde M, et al. Comparative analysis of total body and dermatoscopic photographic monitoring of nevi in similar patient populations at risk for cutaneous melanoma. *Dermatol Surg*. 2010;36:1087-1098.
11. GigaPan Web site. http://www.GigaPan.com. Accessed October 18, 2013.
12. Zepedro Russo Web site. http://www.zpr360.com. Accessed October 21, 2013.