



Mobile Teledermoscopy—Melanoma Diagnosis by One Click?

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Mobile telemedicine integrates wireless communications for different telemedical applications, such as mobile phones and personal digital assistants, and with the implementation of modern wireless telecommunication, wireless local area network and satellite communication is a reality. New generation cellular phones or personal digital assistants have overcome limitations of image quality seen in older devices and, with dermatology being a visual profession, mobile teledermatology is perhaps the most recent development in this field. Mobile teledermatology may provide a triage service aimed toward management of patients with emergent skin disease or for follow-up with patients requiring systemic treatment. Teledermoscopy enables rapid transmission of dermoscopic images via e-mail or specific web-application and studies have demonstrated a high, 91%, concordance between face-to-face diagnosis and remote diagnosis of such images. Further to this, telediagnosis of melanocytic skin neoplasms achieved a diagnostic accuracy of 83% versus the conventional histopathologic diagnosis. Mobile teledermoscopy is the combination of such approaches enabling transfer of images captured with cellular phones coupled with a pocket dermatoscope and preliminary studies have demonstrated the feasibility and potential of its use in triage of pigmented lesions. Such applications are of benefit to physicians in enabling easy storage of data for follow-up or referral of images for expert second opinion and may facilitate a “person-centered health system” for patients with numerous moles and pigmented skin lesions who could forward images for evaluation. The incidence of skin cancers has reached epidemic proportions among whites and the trend is still going upward. Mobile teledermatology and teledermoscopy may be implemented as a triage or screening tool for malignant tumors to facilitate early detection and diagnosis, which is crucial for improved patient outcomes. While the legal aspects concerning teleconsultations need to be evaluated, the communications technologies provide a unique opportunity for physicians and patients alike and we foresee a place for these tools in dermatology soon.

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The term mobile telemedicine is widely used and encompasses a wide range of telemedicine applications. Mobile telemedicine integrates wireless communications for different telemedical applications. Stationary devices are replaced by small portable devices, such as mobile phones and personal digital assistants (PDAs). With the implementation of

modern wireless telecommunication using a global positioning radio system or a universal mobile telecommunications system, wireless local area network and satellite communication is a reality. The power of these devices allows their use in more demanding tasks, such as processing medical images.^{1,2} Recently, their use in telemedicine, particularly in teleradiology and teledermatology, has been successful. As dermatology is a visual profession, it is a promising candidate for various aspects of telemedicine in general, and mobile teledermatology is the most recent development in this field.³⁻⁶

Despite limitations of the first-generation mobile-phone cameras, preliminary studies point out the usability and feasibility of similar devices in mobile teledermatology.²⁻⁶ Modern PDAs and mobile phones of the second and third generation revolutionize the dimensions of data transmission,

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network coverage, and number of pixels. As a result, technical limitations can be reduced to a minimum.¹

Mobile Tele dermatology

Photographs of skin lesions taken using the new generation of cellular phones or PDAs do not have the limitations in image quality due to the optical systems presented by the old devices.⁷ Mobile tele dermatology using PDAs and/or cellular phones could be a filtering or triage system allowing a more rational approach to the management of patients with emergent skin diseases. It can also be used to follow-up with patients who have chronic skin diseases that need systemic treatment (ie, patients with psoriasis treated with BioLogicals).⁸ Patients themselves will capture images with cellular phones and send them via specific mobile applications to a dermatological service. Finally, mobile tele dermatology is able to receive data and images from areas where Internet connection is not available or too expensive (ie, satellite transmission). In this context, mobile tele dermatology will grow exponentially soon.²

Tele dermatoscopy

Clinical and dermoscopic images of pigmented skin lesions can be transmitted over telecommunication networks via e-mail or a specific web application. The feasibility of tele dermatoscopy reveals a 91% consensus between the face-to-face diagnosis and the remote diagnosis.⁹ The Consensus Net Meeting of dermoscopy (a virtual meeting of experts from all over the world) was another evident example of the practical applicability of the use of dermoscopy via Internet.¹⁰ In 2003, a pilot study of the dermoscopic-pathologic approach using tele diagnosis for melanocytic skin neoplasms revealed the diagnostic accuracy reached 83% versus gold standard (conventional histopathologic diagnosis by experts).¹¹ A 2-step tele dermatologic approach may be feasible in managing individuals with multiple pigmented skin lesions.¹²

Recently, tele dermatoscopy was evaluated as a filtering system on 219 pigmented skin lesions. Teleconsultations were sent from general practitioners to the pigmented skin lesion clinic of the Department of Dermatology, University of Seville, in Seville, Spain and 49% of the patients were referred to the FTF Clinic. There was agreement among the teleconsultants for both the diagnosis ($\kappa = 0.91$) and for the management options ($\kappa = 0.92$).¹³ In particular, tele dermatoscopy seems to be suitable as a triage system. Examination of lesions (including dermoscopy) without contact with the patient is associated with improper management in about 30% of equivocal melanomas.¹⁴ Nevertheless, in our estimation, tele dermatoscopy is a promising area for further research and development and will be soon integrated in the daily office workflow for diagnosis and management of equivocal pigmented skin lesions.¹⁵

Mobile Tele dermatoscopy

The same approach applies to mobile tele dermatology; namely, to capture images with cellular phones by applying

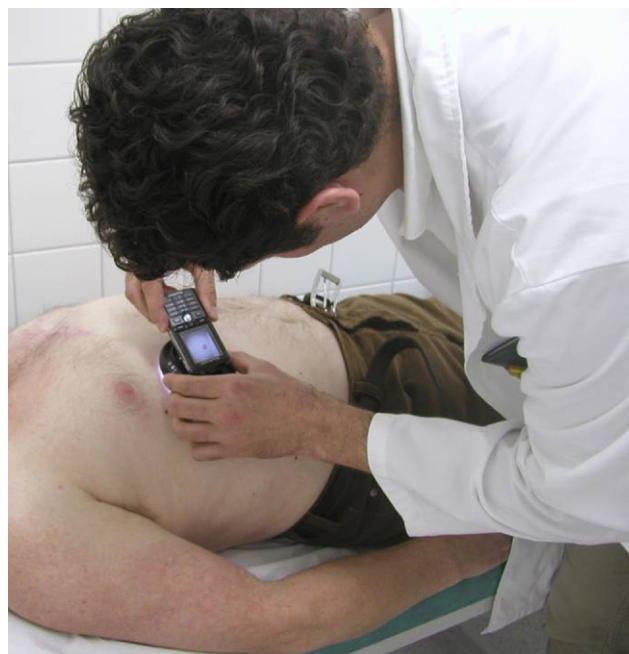


Figure 1 Mobile tele dermatoscopy: acquisition of a dermoscopic image applying the in-built camera of the cellular phone directly on the dermatoscope.

the cellular phone to a pocket dermatoscope (Fig. 1). In the previously reported tele dermatoscopic studies, the images had been acquired with an integrated digital dermoscopy device. Mobile tele dermatology has been tested for dermoscopic images and a preliminary study demonstrates the feasibility and the potential of mobile tele dermatoscopy as a triage system for pigmented skin lesions.^{7,16} The resolution of the in-built cameras in the new generation of cellular phones resolves the issue of the image quality found in the previous reports. In fact, routine conditions under which images are captured may be responsible for the problems of image quality (low sharpness, images not perfectly in focus) rather than technical limitations.⁷

Mobile tele dermatoscopy brings advantages both for physicians and for patients. The former have easy-to-use and lightweight tools that allow the rapid acquisition of images of suspected pigmented skin lesions. Images can be stored in a digital archive for follow-up control or dermoscopic-pathologic correlation or sent to expert colleagues for a second opinion. This methodology needs only a new-generation cellular phone with a built-in camera, a dermatoscope suited for image acquisition, and a personal computer. The dermatologist should possess these basic tools, which are lighter and more practical than the normal equipment used to acquire dermoscopic images (ie, a conventional high-resolution camera with dermatoscope or a system that is not portable, such as Molemax).

In accordance with the new formulated concept of the "Person-centered Health System," this approach could open up new horizons for persons with numerous moles and suspicious pigmented skin lesions.¹⁷ In fact, 1 of the cardinal points of the eHealth program of the European Commission

Information Society and Media is the prevention and management of diseases through research on "Personal Health Systems." The hallmark of this concept is to empower citizens to adopt an active role in managing their own health status and, in addition, facilitating early diagnosis of diseases.¹⁷ In this context, mobile teledermatology and mobile teledermoscopy have the potential to become a practical tool for everyone and may open the door for a new flexible triage system for detection of skin cancer in general and melanoma in particular. A person concerned about a changing mole or a new mole can capture an image of a given lesion with a cellular phone and send it via the Internet to a specialized telemedicine center for triage. Certainly, the legal aspects concerning teleconsultations have to be reevaluated based on a new definition of doctor-patient relationship and prospective. Randomized clinical studies are needed to test and standardize the proposed mobile triage system for pigmented skin lesions.

Conclusions

The incidence of skin cancers has reached epidemic proportions among whites and the trend is still going upward. Early detection is crucial, especially concerning melanoma, as surgical excision today is the only life-saving approach for skin cancer. Mobile teledermatology might be implemented as a filtering or triage system allowing a more sensible approach for the management of patients with emergent skin diseases. Teledermoscopy and mobile teledermoscopy may become a screening tool for malignant cutaneous tumors and can advance the reliability of diagnosis by expert consultations without expensive and time-consuming relocations. Consequently, the quality of patient's care can be raised and the costs of the health care system can be reduced. In fact, a recent publication by Moreno-Ramirez and colleagues showed that the cost ratio between teledermatology and conventional care was 1.6 with an incremental cost of €49.59 per patient in favor of teledermatology that resulted in a more cost-effective, or dominant, methodology. In a public health system equipped with an intranet, the routine use of teledermatology in skin cancer clinics is a cost-effective method of managing referrals.¹⁸

Mobile teledermoscopy represents a new tool for dermatologists to acquire images of suspected pigmented skin lesions, as the methodology is uncomplicated and intuitive and does not need specific devices.

Mobile teledermatology might become a triage system for skin cancer: patients themselves can capture images of suspected skin lesions and send them through the Internet or a cell phone to a referring center.

We foresee that soon mobile telemedicine will exceed its current limits and will be implemented in various fields of medicine. Mobile phones may have a special function for

online consultation, including advice and follow-up for dermatological conditions and a triage system for new and suspicious moles. It is already possible to foresee that soon there will be an icon on the screen of cellular phones to search for a telemedical consultation, including advice for dermatological conditions to allow a virtual triage for new and suspicious moles. Mobile teledermatology and mobile teledermoscopy are paving the way for a more patient-centered health approach for individuals with dermatologic conditions in the spirit of the eHealth program of the European Commission for Information Society and Media.

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