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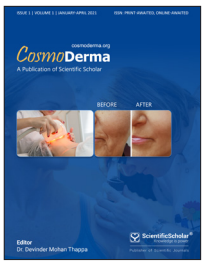

Perspective

Objective diagnostic tools in dermatology – A fast-growing field

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ABSTRACT

The classical dermatology is based on the five common senses, experience, and histopathology. New technologies have become available, which offer new insights into the skin and its various diseases. Optical technologies and artificial intelligence offer a wide spectrum of information, which may improve accuracy and speed of diagnostics. Some of them also offer objective parameters.

Keywords: Diagnostics, Optical technologies, Artificial intelligence

One of the essential qualities of a good clinical dermatologists is to read the skin. The description of what we see, however, is dependent on many factors such as experience, knowledge, illumination, skin color, and pre-treatments. This can become a disadvantage when multicenter trials are planned.

Tools for an objective measurement would be most helpful to overcome this problem.

Some of the classical technical equipment in everyday dermatology are the magnifying glass, Wood's lamp, or the microscope. In recent years, the choice of gadgets has been growing very fast [Table 1]. Some have been introduced in the dermatologic practice, other are so sophisticated and expensive that only large hospital departments can afford.

A successful story has been written on dermoscopy or dermatoscopy – not only for pigmented lesions. The technology is rather simple and robust and can be taken in the smock pocket. However, we are far away from objective measurements. Even with the support of consensus recommendations on technical terms and diagnostic algorithms, the result is subjective. Using neural networks, digital image analysis provides comparable findings that are independent from the user. This is particularly helpful in the diagnosis of early melanoma.

Looking deeper into living skin is possible with confocal microscopy (CM), which comes either as reflectance or fluorescence CM. The procedure used an 830 nm laser light. CM needs a higher investment and a longer training before it can be used to improve diagnosis of non-melanoma skin cancer. Another option represents optical coherence tomography (OCT), which works with infrared and near-infrared light. The basic principle of OCT is interferometry. The resolution cannot compete with classical microscopy using skin biopsies. Epidermal and upper dermal structure can be analyzed. Investment is high and training curve is long. Although CM and OCT are highly sophisticated tools, interpretation of measurements remains subjective.

Table 1: Diagnostic technologies in dermatology and cosmetic dermatology.

	Dermatology	
	Clinical	**Cosmetic**
Digital photography	x	x (documentation)
Total body photography	x	x (documentation)
Dermoscopy/dermatoscopy	x	x (pigmentary and hair disorders)
Confocal microscopy	x	x (pigmentary disorders, stretch marks)
Optical coherence tomography	x	x (rejuvenation)
High-frequency ultrasound	x	x (rejuvenation)
Multispectral optoacoustic tomography	x	-
Fluorescence imaging	x	x (rejuvenation)
Multi- and hyper-spectral skin imaging	x	-
Multiphoton tomography	x	x (rejuvenation)
Spectroscopy	x	x (rejuvenation, photoprotection)
Artificial intelligence	x	x (pigmentary and hair disorders, rejuvenation)

Spectroscopy is a non-invasive technique. It works either with fluorescence as remittance spectroscopy, electrical impedance, or Raman spectroscopy. The technique has been used to characterize wounds and microcirculation, and non-melanoma skin cancer. Interpretation of results needs experience. At present, the major field for spectroscopy is pharmacology and basic science.

Multiphoton tomography uses a femtosecond laser. It offers high-resolution and three-dimensionality. Upgraded with a two-beam multiphoton tomography for clinical coherent anti-Stokes Raman spectroscopy, it can be used for inflammatory skin diseases, skin physiology, and pharmacology. This is high-end technology.

Multi- and hyper-spectral skin imaging (MHSI) seems promising investigation of microcirculation where the local distribution of oxygen in tissue like skin is of major importance. This technique had been used in space missions. The technology offers the opportunity of extracting spatial-spectral information from a tissue image. It uses a number of different spectra. MHSI has been employed in objective measurements in chronic leg ulcers.

Artificial intelligence (AI) uses large databases for simulation of human learning and decision-making. The human perception can be surely improved by AI-based filters, using histogram equalization and training set parameters, to enhance peculiar features. Algorithms and rules-based methods have been reported to be very useful for teaching and providing a sort of flowchart to non-experienced dermatologists. The use of the traditional pattern analysis method in conjunction with a well-trained AI equipment seems to be actual a reliable tool.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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