PROGRAM

WORLD CONGRESS OF THE
International Society for Biophysics and Imaging of the Skin (ISBS)
Emerging Measurements Meets The Cutting Edge In Medicine
JUNE 2-4, 2014
FOXWOODS PEQUOT RESORT
MYSTIC, CT USA

Scientific Committee

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- **Martha Tate, Ph.D.**
- **Stacy Hawkins, Ph.D.**
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- **Stacy Hawkins, Ph.D.**

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- **Tami Luckey**

Welcome to the 2014 World Congress of the International Society for Biophysics and Imaging of the Skin.

As the local host of the congress, I want to welcome you to Connecticut! Whether this is your first encounter with a meeting of the Society or you've been a regular attendee for many years, you are bound to learn something new that can inspire your work when you return home. This is a "small" meeting, so we have planned plenty of opportunity to discuss shop informally. Please take advantage of this opportunity and network with some colleagues. We hope you enjoy the plenary session and scientific posters along this year's theme of *Emerging Measurements Meets The Cutting Edge In Medicine.*

All podium sessions will be held in the Pequot Ballroom A. The exhibits, session meals, and coffee breaks will be in the Pequot Ballroom C, and the poster session and registration/information desk will be located in the Pequot Foyer just outside Pequot Ballrooms A and C. The registration/information desk will be open daily Monday through Wednesday at 8am.

If you are giving a podium talk, please bring a copy of your talk to the A/V desk on the morning of your session. You may preview your talk during breaks. If you are presenting a poster, please display during the full session. Posters should be available from 1pm on Monday, and taken down during the final break on Wednesday.

On Monday night, the welcome reception will be held at Paragon Restaurant on the 24th floor of the Grand Pequot Tower at 7pm. The restaurant offers spectacular views of the surrounding countryside.

Then on Wednesday night, the Gala Event will be held at Mystic Seaport. At 6:30pm, buses will depart from the Pequot tower front entrance (please meet in the lobby). We will arrive at Mystic Seaport by 7pm. From 7-8pm don't miss the complimentary boat rides (the boat will depart just outside the outdoor reception area 3 times during the cocktail hour). A full buffet dinner will be served at 8pm, and live entertainment will be provided after dinner.

I hope you enjoy the scientific and social programs, and your stay while in CT!!

Best wishes on behalf of the organizing committee,
Stacy Hawkins
ISBS World Congress 2014

Things to do:

If you will be staying on for part of the day on Thursday, please consider a visit to the area's museums and attractions. The concierge can assist with directions and best transportation options:

Mystic Seaport and Village – a working village and review of the area's shipbuilding history.
Olde Mistick Village Shoppes – stroll the beautiful lanes and enjoy shopping in distinctive buildings designed to represent a New England Village of about 1720.
Mystic Aquarium – an interactive aquarium with daily feedings and marine shows. Featured exhibits include beluga whales, seals, sea lions, penguins, a variety of coastal birds and jellyfish.
Mashantucket Pequot Museum & Research Center - Multi-sensory dioramas and exhibits introduce visitors to the history of the Mashantucket Pequot Tribe and the natural and cultural history of the eastern woodlands. Films and videos, interactive programs, archival materials, ethnographic and archaeological collections, commissioned art, and traditional crafts by Native artisans are featured in the exhibits – one of the largest collections in North America. The museum is open Wed-Sat.

At Foxwoods there are many things to do on property, including a golf course, scenic walking/jogging trails (maps are available on request at the front desk), a bowling alley, comedy club, shops, full service spa, exercise rooms. Please enquire at the front desk for suggestions on dining, as there are many restaurants available at the resort.

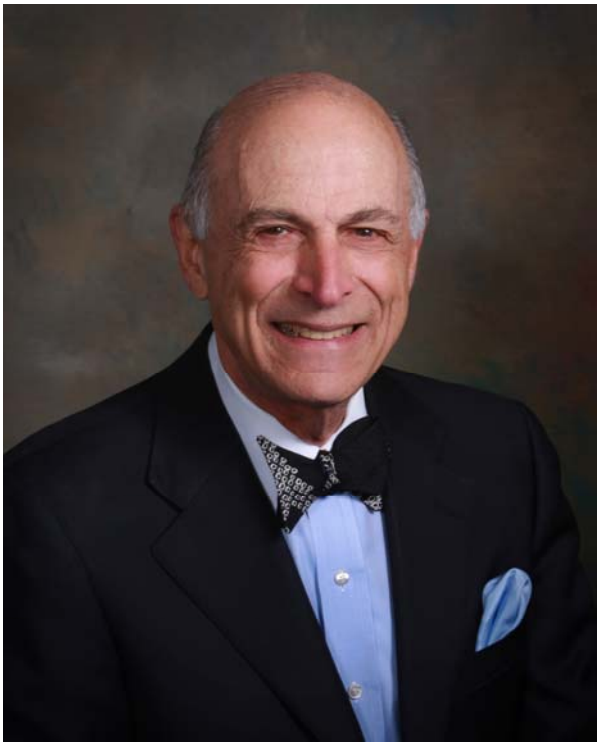
Dining in Mystic:

In the Mystic, CT area there are a variety of restaurants in an around town, and at the Olde Mistick Village area.

Some local favorites around the town include:
S&P Oyster Company – traditional New England seafood fare with a view of Mystic Harbor
Mystic Pizza – the restaurant that the movie is based on is a favorite tourist stop
Captain Daniel Packer Inne and Pub – great for a casual New England lunch in Mystic
Mystic Drawbridge Ice Cream

Title: Aged and Ethnic Skin: Quo Vadis

Author: Howard I. Maibach, MD



Affiliation: Department of Dermatology, University of California, San Francisco, CA 94143-0989

Text: Everyone "knows" aged and ethnic skin / hair – as its "obvious". Yet, when seeking "evidence" – for skin care, data is sparse. Recent textbook (Aging Skin & Ethnic Skin / Hair) summarizes much of the literature. This presentation attempts to define patient / consumer needs – and where answers may be found.

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PRESENT TITLE: Professor

EDUCATION	From	-	To	DEGREE	YEAR
Tulane University, New Orleans, LA	1947	-	1950	A.B.	1950
Tulane University, New Orleans, LA	1951	-	1955	M.D.	1955
USPHS, Hospital of the University of Pennsylvania	1959	-	1961	Resident / Fellow	

HONORARY DEGREES

L'Universite de Paris-Sud	Ph.D.	November 18, 1985

Université Claude Bernard Lyon 1, Ph.D. November 19, 2008
Lyon, France

Dr. Maibach joined the University of California Faculty in 1961, as Assistant Professor, and is currently Professor of Dermatology.

Dr. Maibach's bibliography includes more than 2650 publications and 90 books.

His most active fields of research are in dermatopharmacology, dermatotoxicology, and environmental dermatoses. He has been doing human subject research for 45 years. He is a consultant to government, academia, and industry worldwide. He is the recipient of the Master Dermatologist Award from the Annual Conference of the American Academy of Dermatology in Miami Beach in March 2013.

High-speed, Biopsy-quality 3D Images of Skin with Gabor Domain Optical Coherence Microscopy

J.P. Rolland1,3, P. Tankam1, A.P. Santhanam2, C. Canavesi3, K.S. Lee1,4, P. Meemon1,5, and S.F. Ibrahim6

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Key words: high-definition; skin imaging; optical biopsy; 3D microscopy; optical coherence tomography

Introduction The skin is the largest organ of the human body. Its key functions are to cover the internal organs, serve as a barrier to external pathogens and elements, and control haemostasis through thermoregulation and prevention of water loss. Skin is opaque to the human eye and microscopes that are limited to imaging and visualizing its surface. The ability to image below the skin at micrometer scale in three-dimensions (3D) is enabling across many areas of applications. Objectives In this work, we aim to develop and demonstrate a high-definition imaging microscope to reveal human tissues in 3D at micrometer-scale resolution. Furthermore, real-time image processing is needed to enable 3D imaging not only in clinical settings, but also in research or industrial environments. Methods We conceived, designed, and assembled a microscope optical head with a liquid embedded lens, and with no axially moving parts, that refocuses in tissue without adding optical aberrations that may be caused by light penetrating deep into the tissues. We also conceived and developed a high-speed 0.1 nm spectral resolution spectrometer centered around the

wavelength of 800 nm that accommodates 120 nm bandwidth that enables imaging up to 2 mm below skin. These optical head and spectrometer were integrated into a custom interferometer fiber setup where the current high-speed spectrometer handles 70,000 A-scans per second data acquisition rate. The acquisition time varies as a function of the size of the sample and is in the order of seconds to minutes. Finally, we reconstruct 3D images of skin via a set of algorithms that will be highlighted and were recently integrated into a parallelized multi Graphics Processing Units (GPU) architecture. This emerging technology, enabling micrometer-class 3D microscopy, is referred to a Gabor domain optical coherence microscopy (GDOCM). Results In this work, we show cellular resolution 3D images of different anatomic locations of in-vivo normal skin such as the nail-fold, forearm, and fingertip. We also applied volumetric GD-OCM at cellular resolution to the morphologic investigation of ex-vivo NMSC, comparing cellular OCM images with 3D features of normal and abnormal skin (i.e. BCC and SCC). Ex-vivo 3D images through the cornea, the "skin" of the eye, revealing various types of cells including endothelial cells will also be reported. The proposed parallelized multi-GPU computing framework enables processing at a computational speed faster than the GD-OCM image acquisition, thereby facilitating high-speed GD-OCM imaging. Using two parallelized GPUs, the image processing of a 1 × 1 × 0.6 mm3 skin sample was performed in about 13 s, and the performance was benchmarked at 6.5 s with four GPUs. Conclusions GDOCM, an emerging technology for 3D imaging at micrometer-class resolution has been integrated within a multi-GPU processing platform. This work demonstrates that 3-D GD-OCM data may be displayed in real-time using parallelized GPU processing, enabling a large range of applications related to, among other materials and biomaterials, skin imaging. Competing financial interests: J. P. R. and C. C. are co-founders of LighTopTech Corp., which is licensing intellectual property from the University of Rochester related to Gabor Domain Optical Coherence Microscopy. Other authors declare no competing financial interests.

Jannick Rolland is the Brian J. Thompson Professor of Optical Engineering at the Institute of Optics at the University of Rochester, NY, and Fellow of OSA and SPIE. She directs the NSF-I/UCRC Center for Freeform Optics (CeFO), the R.E. Hopkins Center, and the ODALab (www.odalab-spectrum.org). She earned a PhD from the College of Optical Sciences at the University of Arizona, USA. She is the recipient of the 2014 OSA David Richardson Medal awarded.

New Insight in Skin Biomechanics Through Combined Approaches: Measurements and Numerical Simulations

Cormac O. Flynn

Centre for Engineering and Industrial Design, Wintec, Private Bag 3036, Waikato Mail Centre, Hamilton 3240, New Zealand.

Abstract

Quantifying the mechanical properties of human skin is a challenging endeavour. Skin is a complex material, which varies according to age, body location, and physical health. In addition, it is in a state of tension, which also varies from person to person. There are many benefits to overcoming these challenges, including improved identification of skin pathologies, better design of artificial skin, and superior surgical incision methods to reduce scar formation. Better knowledge of skin properties also leads to improved design of personal care products that interface with skin, such as razors, sticky-plasters, and moisturisers.

Several combined numerical-experimental methods have been developed to characterise the mechanical properties of skin. Typically, deformations are applied to skin and parameters of an analytical or finite element model are varied until the model results match the experimental results. Experimental protocols have included applying uniaxial or biaxial tension, suction, torsion, and normal indentation. These methods have drawbacks because they only apply deformations in a limited number of in-plane directions (biaxial tension) or are unable to characterise the directional properties of skin (suction, torsion, normal indentation).

In this talk, I will discuss recent developments in characterizing the mechanical properties of human skin. I will detail a numerical-experimental protocol where a rich set of deformations are applied to the surface of in vivo skin and a finite element model is used to simulate the experiment. This method has been applied to estimate mechanical properties and in vivo tensions of different points of volunteers' arms and faces. Results demonstrate the wide variation in skin properties and the importance of a patient-specific model to answer questions.

Underlying this numerical-experimental approach is the use of different constitutive equations of skin to describe its stress-strain behaviour. I will also give an overview of different types of constitutive equations used and some recent fibre-based models that have accurately simulated in vitro tests of human skin.

Congratulations to our Award Winners

Dr. Albert M. Kligman
Young Investigator Scholarship
Awardees to 2014 ISBS World Congress

Charles Bradley, VMD
Dermatopathology Fellow
University of Pennsylvania School of Veterinary Medicine

Presenting PAPER 003.
Epidermal barrier function in dogs: normal vs. dermatologic disease

Lucia Liu,
Ph.D. Student
Binghamton University

Presenting paper 019.
Dynamic drying mechanics of human stratum corneum & effects of moisturization.

Katie Newberger
3rd Year BioMedical Engineering Student
Georgia Tech

Malou Peppelman,
Ph.D. Student
Radboud University Medical Center, Netherlands

Presenting paper 007.
Non-invasive in vivo imaging of dynamic inflammatory processes in the skin by reflectance confocal microscopy.

We are pleased to acknowledge the following sponsors:

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Best Poster Award
Academ

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SCHEDULE OF EVENTS

	June 2, 2014	Title	Presenting Author
Pre-Conference Workshop	8:30 AM	W01: Basics on mechanical and optical evaluation of the skin	Randy Wickett
	9:15 AM	W02: Non invasive methods for skin surface properties	Gary Grove
	10:00 AM	Coffee Break	
	10:30 AM	W03: Cross-sectional imaging methods	Bernard Querleux
	11:15 AM	W04: Guidelines for cosmetic studies	Klaus Wilhelm
	12:00 PM	Lunch	
	1:15 PM	Opening ceremony	
	1:30 PM	Invited Talk: Ethnicity and Aging	Howard Maibach
Session 1: Skin Physiology Co-chairs: H. Maibach, S. Hawkins	2:20 PM	O01: Gender, Skin Type and Age Classification using Skin Reflectance-Based Descriptor	Wei Chen
	2:40 PM	O02: Dynamic response of human hair to a non-contact impact for different water contents according to ethnic origin	Juliette Jamart
	3:00 PM	O03: Epidermal barrier function in dogs: normal vs dermatologic disease	Charles Bradley
	3:20 PM	Coffee Break	
	3:50 PM	Invited Talk: Review on OCT of the Skin	Jannick Rolland
Session 2: Cross-sectional Imaging Co-chairs: J. Rolland, KP Wilhelm	4:40 PM	O04: Human skin morphology monitoring with 22 and 75 MHz high frequency ultrasound in aesthetic dermatology practice	Artur Bezugly
	5:00 PM	O05: High-resolution OCT as a tool to measure stratum corneum thickness: development and validation	Elsa Jungman
	5:20 PM	O06: Non-invasive assessment by optical technology of human acellular dermal matrices processing	Frans Dhaenens
	5:40 PM	O07: Non-invasive in vivo imaging of dynamic inflammatory processes in the skin by reflectance confocal microscopy	Malou Peppelman
	7:00 PM	Welcome Reception	

	June 3, 2014	Title	Presenting Author
	8:30 AM	Invited Talk: Biophysics Basis of Laser Treatments	Stacy Hawkins
Session 3: Medical Applications - Dermatology and Beyond Co-chairs: S. El Gammal, CH Oh	9:00 AM	O08: A human skin model of laser-ablated epidermis applied to the assessment of skin repair creams using instrumental methods	David Black
	9:20 AM	O09: Polymeric micellar nanocarriers: Improved chemical stability and enhanced skin deposition of anti-acne drugs	Sevgi Güngör
	9:40 AM	O10: Integrating Non-Invasive Biophysical Analysis and Multivariate Statistical Modeling into a Comprehensive Framework for Cutaneous Injury, Wound Healing, and Treatment Efficacy Analysis	John Azeke
	10:00 AM	O11: Multimodal Skin Imaging To Quantify Treatment Response in Infantile Hemangiomas	Marty Visscher
	10:20 AM	Break	
Poster Session	10:50 AM	Poster session Odd numbers: 10:50 - 11:40 AM Even numbers: 11:40 - 12:30 PM	
	12:30 PM	Lunch	
Session 4: Clinical Studies Co-chairs: E. Braue, M. Tate	1:30 PM	O12: How to unravel the pathomechanism of sensitive skin. A systematic literature review	Renée Richters
	1:50 PM	O13: Polidocanol inhibits cowhage- but not histamine-induced itch in humans – further characterization of an experimental model of histamine-independent itch	Joachim Fluhr
	2:10 PM	O14: Modification of Skin Discoloration by Topical Treatments: the Effect of an Anti-oxidant	Neelam Muizzuddin
	2:30 PM	O15: Improved skin penetration and distribution of two antifungal compounds using new topical carriers	Meryem Sedef Erdal
	2:50 PM	Break	
	3:20 PM	Invited Talk: Tribology of Skin Adhesion	Hassan Zahouani
Session 5: Skin Surface Properties Co-chairs: H Zahouani, B. Querleux	4:10 PM	O16: Assessment of skin surface roughness of 24 body sites - a validation study of a rapid in-vivo roughness measurement technique based on laser speckles	Tim Lee
	4:30 PM	O17: Development and Organization of Human Stratum Corneum After Birth	Joachim Fluhr
	4:50 PM	O18: Simultaneous measurement of epidermal barrier function with the new Triple-Tewameter Probe in healthy and atopic human volunteers	Joachim Fluhr
	5:10 PM	O19: Dynamic Drying Mechanics of Human Stratum Corneum and the Effects of Moisturization	Xue Liu
	5:30 PM	General Assembly	

	June 4, 2014	Title	Presenting Author
	8:30 AM	Invited Talk: Update in Multiphoton Microscopy of the Skin	Karsten König
Session 6: Microscopy Co-chairs: K König, J. Serup	9:20 AM	O20: Confocal Microscopy and Characterization of Mechanical Properties of Human Skin	Simon Tupin
	9:40 AM	O21: Control of nuclear deformability by lamins: implications for cancer cell invasion into skin-like tissue environments	Marina Krause
	10:00 AM	O22: Evaluation of RSDL and measurement of VX depth profiles in hairless guinea pig skin using confocal Raman microspectroscopy	Ernest Braue
	10:20 AM	O23: Nanoscale Infrared Spectroscopy and Imaging of Structural Lipids in Human Stratum Corneum Cross Sections	Curtis Marcott
	10:40 AM	Break	
Session 7: Clinical Studies II Co-chairs: N. Muizzuddin, J. Fluhr	11:10 AM	O24: The development and validation of Skin Damage Area and Severity Index to access sliding induced skin injuries on artificial turf	Wilbert van den Eijnden
	11:30 AM	O25: A Retrospective Study Evaluating the Use of a Probiotic Combined with Zeaxanthine on Acne Lesions and Post Inflammatory Hyperpigmentation	Robert Frumento
	11:50 AM	O26: Effect of a Test Cream on Irritant Hand Dermatitis in Health Care Workers	Ward Billhimer
	12:10 PM	Lunch	
Session 8: Emerging Methods Co-chairs: R. Wickett, M. Visscher	1:30 PM	O27: Using the digital camera as a transducer for assessment of the skin	Gert Nilsson
	1:50 PM	O28: Multi-Scaling 3D measurement of the skin Face & body	Jean-Jacques Servant
	2:10 PM	O29: Clinical application of refractive index radiology	Jae-Young Kim
	2:30 PM	Break	
	3:00 PM	Invited Talk: New Insight in Skin Biomechanics	Cormac Flynn
Session 9: Skin Biomechanics Co-chairs: G. Grove, E. Braue	3:50 PM	O30: Skin stiffness assessed in vivo using 20 MHz ultrasound shear wave elastography: age-related effects	Bernard Querleux
	4:10 PM	O31: Assessment of Human Skin Mechanical Tension by Local No Contact impact and Surface Wave Propagation Analysis: Ageing and Gender effect	Djaghloul Mehdi
	4:30 PM	O32: Biomechanical Properties of Pediatric Skin and Infantile Hemangiomas	Randy Wickett
	4:50 PM	O33: Internal stress and tension forces of human skin during aging	Hassan Zahouani
	5:10 PM	Poster Prize and Closing Ceremony	
	6:30 PM	Gala Dinner - Buses Depart for Mystic Seaport	

POSTER SESSIONS

Poster #	Title	Presenting Author
P01	Gender, Skin Type and Age Classification using Skin Reflectance-Based Descriptor	Wei Chen
P02	A Photonumeric Crow's Feet Grading Scale	Tim Houser
P03	Comparative Efficacy of Skin Lightening Technologies in Multiple Country Populations	Valentina Kazlova
P04	Distribution of corneodesmosomes on superficial corneocytes differs between infants and adults: a new look at the stratum corneum maturation	Nadège Lachmann
P05	Surface Isotropy as a Marker for Epidermal Maturation in Infancy: Development and Validation of the Electron Microscopy Isotropy (E.M.I) Score	Nadège Lachmann
P06	Regulation of skin water flow: evaluation of a vegetable extract, from in vitro efficacy to clinical evidence using Raman Spectroscopy	Nadège Lachmann
P07	What is different in skin physiology in neonates and young children of different age groups compared to adults? A randomized in vivo study	Nadège Lachmann
P08	Vascular inflammation and innate immunity modulation: ways for skin blemishes correction	Nadège Lachmann
P09	The skin analysis system based on image pattern for both simple and multi-meaning evaluation; Hydration pattern, and skin texture pattern	Joon Oh Myoung
P10	Applications of Reflectance Confocal Microscopy in Skin Penetration Efficacy Testing and Ingredient Screening	Rong Kong
P11	Improved quantification of skin erythema pattern by color analysis of highly standardized photographic images	Klaus-P. Wilhelm
P12	SPHINGANINE - The hair cycle balancer	Annika Schrader
P13	In vivo Imaging of superficial suction blister wounds by confocal reflectance microscopy	Klaus-P. Wilhelm
P14	A Novel Cosmetic Formulation for Photo-Rejuvenation	Alexander Zemtsov
P15	Does topically applied ceramides permeate into stratum corneum and constitute skin barriers?	Guangru Mao
P16	Quantitative analysis of engineered skin regeneration using 3D optical coherence tomography	Youjin Ahn
P17	A clinical tool to identify subjects with sensitive skin	Renée Richters
P18	Photoacoustic molecular imaging of ferritin as reporter gene in SK-MEL-24	Seunghan Ha
P19	Quantitative Analysis of Multiple Photoaging Features using Image Analysis of Digital Photographs	Lily Jiang
P20	Infantile Hemangiomas: Progression and Dynamic Infrared Thermography	Marty Visscher
P21A	Non-invasive contrast enhanced fluorescent imaging	Jaeyoung Kim
P22	Integrating Non-Invasive Biophysical Analysis and Multivariate Statistical Modeling into a Comprehensive Framework for Cutaneous Injury, Wound Healing, and Treatment Efficacy Analysis	John Azeke
P21B	Usefulness of hard x-ray microscope using synchronous radiation	Onseok Lee

Technical Showcase

We are pleased that the leading manufacturers will be showcasing their latest innovations in non-invasive instruments and imaging systems in concert with our meeting. This will be an unmatched opportunity to see the state of the art for the entire industry, all in one place. The contact information for exhibitors and social program sponsors are provided below:

Instrument Suppliers	Web Page	Contact	email
Acaderm		Todd Maibach	acaderm@aol.com
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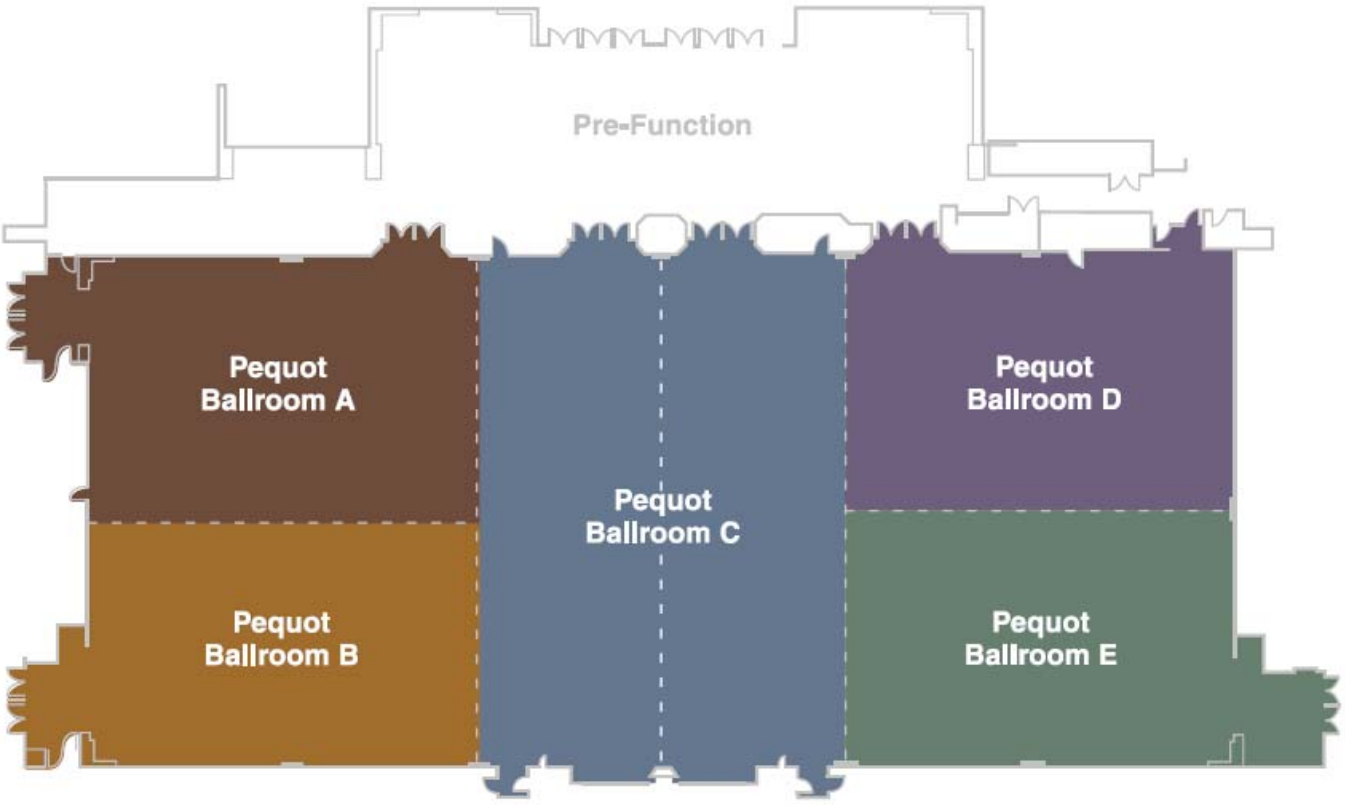
Please Visit the ISBS website, http://www.i-s-b-s.org/ for links to more information.

Meeting Map



ABSTRACTS

O01

Gender, Skin Type and Age Classification using Skin Reflectance-Based Descriptor

Wei CHEN, Mohsen ARDABILIAN, Hassan ZAHOUANI, Abdelmalek ZINE
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KEY WORDS: gender, skin type, age, classification, skin diffuse albedo, skin thickness, human skin biophysics

INTRODUCTION: Demographic attributes as gender, ethnicity and age play an important role in many applications such as demographic statistics, targeted advertising, medical diagnosis etc. Identification of these attributes has gained increasing attention and has been widely investigated. The state of the art methods can be divided into 2 categories: geometric-based and appearance-based methods. The first category of methods tend to estimate the distances between manually maintained facial landmarks, nevertheless some useful information may be thrown away. The second extracts texture or shape information from passively acquired facial images. Both categories yield satisfying results in gender identification; however, they are inefficient in ethnicity and age identifications, especially for intermediate classes. Alternatively, some researchers focused on actively acquired hyper-spectral images, they use biophysics of the human skin to synthesize histological parameters for ethnicity classification. To the best of our knowledge, few works utilize a biologically founded feature such as skin reflectance for gender, skin type and age classifications simultaneously with satisfying rate.
In this study we first introduce biophysical basis of the human skin albedo and its correlation to demographical attributes such as gender, skin type and age. We propose to use the albedo as a feature through a classification scheme to estimate such demographical attributes. The proposed approach is then applied on ten facial regions. Finally we introduce a weighted sum fusion technique. These weights, for different regions, are computed by genetic algorithm and described through skin thickness. Our results show that the proposed approach is very efficient, and can yield results supported by the biologist's considerations.

METHODS: The skin reflectance is a highly discriminative feature for gender, skin type and age, but is difficult to acquire, for skin is a translucent and multi-layered material. Several skin reflectance models are developed due to various applications (Gladimir V.G. Baranoski et al., 2010). BSSRDF (bidirectional surface-scattering distribution function) is a Jensen theory-based analytic reflectance model (Jensen et al. 2001), which allows the reflectance calculation for all translucent materials, and is widely used in realistic facial image synthesis.

In our approach, we turn to extract our reflectance distribution signature for gender, skin type and age classifications. With the diffuse albedo, we extract our descriptor in each facial region by calculating the albedo distribution histograms of RGB channels, and then concatenate the 3 histograms in order of RGB.

The MERL/ETH database (Weyrich et al., 2006) contains reflectance information of 156 subjects labeled with gender, 6 Fitzpatrick skin types and ages from 13 to 74, which is acquired from the 10 facial regions described above. We define 5 skin type classes (I & II, III, IV, V, VI) and 4 age classes (under 25, 25 to 30, 30 to 40, above 40).

The classification is performed using RBF-kernel SVM. We randomly over-sample and under-sample each class in order to make the number of subjects in each class is suitable for the cross validation, same subject will not be appear both in training and testing stage. The result is evaluated by a 10-fold cross validation, the data is divided into 10 partitions, in each round, 7 of which are used in training, and 2 of which are for the testing stage, the remaining partition is reserved for the classifier fusion. The fusion stage is performed using a weighted sum, where the weights are computed through genetic algorithm.

RESULTS: We perform gender, skin type and age classifications in 6 regions with sufficient data; a single classification rate is calculated by combining all 10 rounds of validation. The results are listed below (Tab.2).

The region 2 yields the highest results among the 6 tested regions which reaches 93.44% of accuracy, and is comparable to the state of the art results; on the contrary, region 8 has the lowest results except for skin type classification. The results for skin type and age classifications are not very efficient, so we perform a late fusion by calculating the weighted sum. We first select 5 regions (1, 2, 6, 7, 9), and compute the weights for each region with the remaining partition, then we obtain the classification results with the 2 testing partitions; finally we compared the fusion results with the highest results before fusion (Tab.3).

There is a significant increase both in skin type and age classifications (13.75% for skin type and 17.82% for age).
The weights varies in small intervals, for both gender and age classifications, the weight increases while skin thickness increases, because male have thicker skin than females, thicker skin contains higher density of melanin which contributes the most to the skin color; skin is also continuously exposed to sunlight which stimulates melanocyte producing more melanin as stated by Ortonne (Ortonne, 2006). But for skin type classification, the weight increases with the decrease of skin thickness, this is probably because people with higher pigmentation level will be less sensitive to sunburn but easier to get tanned, and thinner regions shows relatively more stable properties under the exposure of the sunlight according to Fitzpatrick (Fitzpatrick, 1988).

CONCLUSION: The purpose of this study is gender, skin type and age classification based on skin albedo feature. Using a biophysically based skin model, our fusion classification results reached 96.88%, 95% and 90.63% for gender, skin type and age respectively. The relations between weights and skin thickness are confirmed by biologist's considerations. Our approach is promising and may also inspire future studies on demographic attributes classification or medical diagnosis in various applications.

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O02

Dynamic response of human hair to a non-contact impact for different water contents according to ethnic origin

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Keywords : Hair, Ethnic Origin, Water content, Desorption kinetic, Vibration, Mechanical properties

1. Introduction

Human hair is a non-homogeneous complex material which can be associated with a composite. It is made of keratin fibers embedded in an amorphous matrix and all oriented in the longitudinal axis which offers stronger mechanical properties in this direction. It is well known that these properties are highly sensitive to environmental conditions such as relative humidity because of the ability of the matrix to absorb or desorb a large quantity of water. However, this ability is also dependent on ethnic origin. A. Frambourg et al. have shown that water absorption rate is dependent on ethnic origin. Moreover, African hair is known to absorb a smaller quantity of water than Asian and Caucasian hair. Classical mechanical testing techniques usually applied to fibers such as tensile and relaxation tests are able to measure the difference of mechanical behavior for samples at different relative humidities but it is not possible to follow the evolution of properties during the kinetic of desorption peculiar to each ethnic group.

2. Objectives

A non-destructive technique, more precise and faster than the classical testing techniques is needed in order to follow the kinetic of desorption and its effect on the mechanical properties of a hair fiber according to its ethnic origin. Thus, a new mechanical approach based on vibration propagation has been developed using a solicitation without any solid-solid contact.

3. Methods

In this study, the hair fiber is stimulated with an air blast creating an extremely precise impact on the fiber in order to create a vibration. Then, deflection is measured at the impact point and the propagation is followed by measuring the vibration at 40 mm from the impact. Thanks to both signals, the dynamic behavior of hair can be measured giving information about the mechanical and energetic response of the fiber.

This measurement has been applied to African, Asian and Caucasian hair samples before and after vaporization of distilled water and at different times of desorption. In order to characterize the induced vibration, several parameters have been selected and estimated such as the wave propagation delay, the vibratory level, the attenuation coefficient of the signal and its natural frequency.

4. Results

When the sample gets wet, an increase of the attenuation coefficient and a shift of the natural frequency towards high frequencies can be observed. This method is therefore able to discriminate these two states. In Figure 4, the kinetic of desorption can be followed by observing the evolution of both vibratory responses. As the vibratory response is mainly related to the intrinsic mechanical properties, this method can also attest to the changes of mechanical behavior due to the evolution of water content. Difference in the kinetic evolution of the vibratory responses has been observed for the three ethnic groups and the absorption tendencies observed in Figure 1 has been confirmed.

5. Conclusions

Based on the dynamic response of a hair fiber to an extremely brief impact, the evolution of its mechanical properties during the kinetic of water desorption can be followed. The real benefits of this method lie in the ability to correlate the

vibratory response to the intrinsic mechanical properties. This mechanical approach represents a new tool able to discriminate hair fibers according to their ethnic origin.

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O03

Epidermal barrier function in dogs: normal vs dermatologic disease

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Key words: skin barrier testing, transepidermal water loss, corneometry, dogs, veterinary, atopic dermatitis

Introduction: Atopic dermatitis is a common skin disorder in dogs that closely mimics the natural disease state in people, providing a spontaneous animal model for this condition. Objective assessment of skin barrier function in normal and disease states is lacking in veterinary medicine, leading to a gap in the characterization of these models. Species specific cutaneous anatomy and physiology (e.g. a lack of eccrine glands in haired skin, epidermal thickness, and hair follicle structure) must be taken into consideration when applying barrier function assessment techniques.
Objectives: Our primary aim was to assess the feasibility of epidermal barrier testing in dogs. Our secondary aim was to perform a pilot study employing epidermal barrier function measurements in normal dogs and dogs affected with dermatologic disease (atopic dermatitis and bacterial skin infection) in a clinical setting.

Methods: Transepidermal water loss (TEWL) by tewametry, epidermal moisture content measured via electrical capacitance (corneometry), and skin pH were assessed in fifteen (15) normal dogs and in fifteen (15) dogs clinically affected with atopic dermatitis. Affected dogs were enrolled by fulfilling clinical criteria of atopic dermatitis following examination by a veterinary dermatologist. All dogs were sampled at multiple sites and followed longitudinally over a three month period.

Results: A normal range was established for tewametry (mean pinna: 16.1 [6.1-49.8], axilla: 18.8 [6.1-63.1], and inguinum: 14.5 [5.7-59.9]) and corneometry (mean pinna: 27.6 [4.1-113.3], axilla: 21.6[4.8-112.2], and inguinum: 19.1 [4.0-109.8]). Average pH for the pinna, axilla and inguinal region measured 7.0, 7.2, and 6.9 respectively. Dogs with dermatologic disease showed elevated and more variable TEWL and moisture content values correlated with disease severity.

Conclusions: Clinical epidermal barrier testing is a useful tool for characterizing canine dermatologic disease. In atopic dermatitis epidermal barrier function testing most strongly correlates with clinical disease flare and bacterial infection. Haired skin is an impediment to barrier testing techniques and species (and breed) specific physiology requires consideration when interpreting results. Our study also supports previous data that the pH of canine skin is more basic than human skin.

O04

Human skin morphology monitoring with 22 and 75 MHz high frequency ultrasound in aesthetic dermatology practice

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Key words
High frequency ultrasound, skin imaging, noninvasive skin diagnostics, skin measuring, quantitative skin analysis, aesthetic dermatology.

Introduction

Objective skin morphological and functional parameters registration and monitoring are priorities for evidence based approach in modern aesthetic dermatology. High frequency ultrasound studies of human skin with 22, 33, 50, 75, and 100 MHz that penetrates the tissue up to 10-16 mm, allow to evaluate the morphological picture of the skin overall, including the epidermis, dermis and subcutaneous fatty tissue.

Objectives

The purpose of this research was to study the possibilities of high-frequency ultrasound in the aesthetic dermatology practice.

Materials and methods

We surveyed 22 patients with acne, studied intradermal distribution and side effects of implants at 15 patients and internal structure of scars at 19 patients. We used digital ultrasound imaging system DUB SkinScanner75 from tpm taberna pro medicum GmbH (Germany) with 22 and 75 MHz applicators. The axial resolution was 72 and 21 µm. We received vertical ultrasound slicer images length 12.8 mm with a depth of 8 mm at 22 MHz and 4 mm at 75 MHz. Quantitative analysis of ultrasound images: the thickness and acoustic density of the epidermis, dermis and subcutaneous tissue were measured. Also we assessed the linear sizes, area and volume of the objects in region of interest.

Results

For patients with acne the size and depth of the infiltrative changes in the dermis and hypodermis were quantitatively described. For patients with acne conglobata more diagnostic information about the transdermal fistulas was received. For patients with intradermal implants we measured depth and volume of implants, intradermal, hypodermal or mixed character of implants distribution. Also some ultrasound signs and quantitative parameters of intradermal implants side effects were described. Some intradermal injections of cross linked hyaluronic acid was made under high frequency ultrasound control, and dynamic of cross linked hyaluronic acid distribution was monitored.
For patients with scars we measured intradermal and hypodermal scars area and volume, depth of scars and borders with normal tissues.

Conclusions

High resolution ultrasound with frequencies of 22 MHz and 75 MHz allows to objectify the internal changes in the epidermis, dermis and subcutis. Quantitative ultrasonic monitoring of the skin condition greatly improves the reliability of comprehensive evaluation of treatment effectiveness in aesthetic dermatology.

O05

High-resolution oct as a tool to measure stratum corneum thickness: development and validation

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Key words: Stratum corneum, thickness, tape stripping, OCT, non invasive, in vivo skin absorption

Introduction

Bioavailability describes the rate and the extent at which a drug reaches its target site. In the case of topical formulation, stratum corneum is the principal barrier to drug absorption. Thus, parameters characterizing diffusion through the stratum corneum (i.e. diffusion coefficient and partition coefficient named dermopharmacokinetic parameters) are key points to interpret drug absorption.

A recent protocol has been developped1 to measure these parameters in-vitro as well as in-vivo. The individual stratum corneum thickness is required to normalize drug permeation profiles in such studies. Several other methods used to measure stratum corneum thickness or/and the amount of stratum corneum removed by tape stripping also exist: UV/VIS2, TEWL3, scanner imaging4... Yet, most of these methods are time consuming, as measurements are done on every individual strips.

Objectives

High-resolution Optical Coherence Tomography (OCT) is a new powerful technique to overcome such limitations. Here, we present results obtained with a custom-modified system (LLTech Light-CT Scanner, Paris) with an optical resolution of about 1 µm in all directions, capable of direct in-vitro and in-vivo measurements of the stratum corneum thickness. The system is based on Full Field OCT technology, acquitting en-face images as a function of depth to generate a 3D representation of skin.

Methods

The OCT protocol was set on ex-vivo human skin and compared to the TEWL approach considered here as a reference method. Then, these 2 protocols were applied on 11 human volunteers.

Results/Conclusion

Good correlation was obtained between the two methods.
This new method may also be used to measure rapidly stratum corneum thicknesses of different skin models, such as pig skin, as well as for bioequivalence studies by tape stripping to quantify stratum removed after a given number of tape strip.

O06

Non-invasive assessment by optical technology of human acellular dermal matrices processing

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Keywords: human acellular dermal matrices (HADM), allograft, Reflectance Confocal Microscopy (RCM), High-Definition Optical Coherence Tomography (HD-OCT), dispase, histopathology, collagen, bloodvessels.

Introduction: Affordable accessibility to living skin equivalents and decellularised allograft dermis is urgently needed. The development of dermal substitutes requires reliable and effective safety controls by means of optical techniques.

Objectives:
1. Non-invasive ex vivo assessement by High-Definition Optical Coherence Tomography (HD-OCT) and Reflectance Confocal Microscopy (RCM) of skin allograft before and during processing of human acellular dermal matrices (HADM)
2. To explore the possibilities of both techniques compared with histopathology

Methods: Cryopreserved allogenic human skin (0.2-0.4 mm thick) was used to prepare HADMs. To remove the epidermis the allogenic samples were incubated either with Dispase II or with 1 M NaCl.
Acellular dermal matrices were obtained by subsequently incubation with either 0.5% Triton X-100 or 0.1% sodium dodecylsulfate (SDS) for 24h.
The several preparation methods were assessed by HD-OCT and RCM and correlated with histopathology for ease of epidermal removal, cellularity and quality of the obtained HADMs.

Results:
1. Despite different splitting level, preliminary results indicate that Dispase II and 1M NaCl are equally efficient in the removal of the epidermis. With SDS remnants of the basal cell layer remained. (Hematoxylin&Eosin staining)
2. Elastic fibre fragmentation was observed in the dermis after use of Dispase II, but not with the use of NaCl. (Orcein staining)
3. SDS was more effective than Triton X-100 for the removal of cell debris from the dermis.
4. HADM obtained by Dispase II/SDS is completely acellular but the quality is poor due to elastic fibre fragmentation and decreased number of vascular holes. HADM obtained by NaCl/Triton X-100 is not completely acellular but the quality is good due to the small impact on the collagen and elastic structures and almost normal looking vascular spaces.
5. RCM has a better resolution but HD-OCT imaging is deeper.

Conclusion: This feasibility experiment shows that each processing step evaluated in the present study affects in some way the quality of the HADMs and therefore care must be taken in choosing appropriate processing steps to maintain selected properties of the extracellular matrix in HADMs.
Both optical techniques are not only very useful but also complementary for morphological assessment of HADMs processing.

O07

Non-invasive in vivo imaging of dynamic inflammatory processes in the skin by reflectance confocal microscopy

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Keywords: Reflectance confocal microscopy, Non-invasive imaging, Skin inflammation, Polymorphonuclear leukocytes

Introduction: Reflectance confocal microscopy (RCM) is an imaging tool that allows in vivo visualization of cellular details without taking a biopsy. Currently, RCM is mainly used for diagnosis of skin cancer and inflammatory skin diseases. Further this technique is used for monitoring and follow-up of dermatological treatments.
Objectives: We questioned whether RCM can be used to study dynamic inflammatory processes in vivo and aimed to visualize the trafficking of inflammatory cells in psoriatic lesions and in the leukotriene B4 (LTB4) skin inflammation model.

Methods: RCM imaging of 12 psoriatic lesions was performed for seven consecutive days with a 24-hour time interval. Further, we topically applied LTB4 on the skin of seven healthy volunteers. RCM imaging was performed before and direct after application of LTB4 and for three consecutive days. 3mm biopsies were obtained in five volunteers. Hematoxylin and eosin and immunohistochemical staining specific for CD3 and Elastase staining were performed for correlation to the RCM images.

Results: In psoriatic lesions a cyclic pattern of neutrophil migration was observed. The time interval of the neutrophil-trafficking cycle was five to seven days. Topical application of LTB4 resulted after 24-48 hours in the appearance of highly reflective cells high in the epidermis corresponding to polymorphonuclear leukocytes (PMN), which degenerated after 72 hours.

Conclusion: We established the dynamics and time-phasing of neutrophil migration in vivo in psoriatic lesions. Further, we showed the ability of RCM to visualize PMN accumulation and degeneration in the established LTB4 inflammation model. These findings, demonstrate the usefulness of RCM imaging in studying dynamic inflammatory processes in the skin.

O08

A human skin model of laser-ablated epidermis applied to the assessment of skin repair creams using instrumental methods.

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Key words : clinical study, Er:YAG laser, epidermal wounds, transepidermal water loss, macrophotos.

Introduction:
Experimental investigation of wound healing in skin ideally requires a technique for producing standardised wounds. Ablative lasers like the Erbium:YAG used routinely for skin resurfacing, have been described for this purpose, providing more uniform epidermal wounds than the suction blister method. This technique was used in a controlled, clinical study, for enabling the comparison of 3 topical cosmetic products for skin repair using instrumental methods.

Objectives:
Determine whether differences in skin repair rate could be measured using the 3 test products on superficial epidermal wounds produced by an erbium YAG (Er:YAG) laser, on healthy subjects.

Methods:
An Er:YAG laser was used on the forearm skin of 21 healthy volunteers to produce 2 uniform epidermal ablations per arm (size 8x8mm, fluence 15J.cm-2). Measurements of epidermal regeneration (wound surface areas, WSA, from macrophotos) and barrier restoration (TEWL), were made at regular intervals up to 22 days during which 3 test products were applied 1-2 times per day. The products were as follows : A – A. rhealba oat extract and hyaluronic acid, B - panthenol and madecassosside, C - resveratrol-copper complex. An untreated control site was included for comparison. The study was double blind, with treatment application being randomised according to the sites.

Results:
Epidermal ablation of the skin was rapidly obtained (1-2 minutes) with uniform WSA (69.43 ± 3.84 mm^2). WSA measurements over the 22-day period showed significant differences in wound closure between products. Products A & B demonstrated a shorter time (9 days) and faster rate of closure than product C (12 days) and the untreated zone (16 days). With regard to barrier function, all 3 products showed a similar rate of TEWL decrease, which was significantly faster than the rate for the untreated control.

Conclusions:
The human skin model of laser-ablated epidermis produces standardised lesions, thus is suitable for the study of skin repair products on these superficial wounds. Measurements over 22 days demonstrated significantly faster healing with the test products compared to an untreated control : wound surface area (A=B>C>Control), barrier function recovery (A=B=C>Control).

O09

Polymeric micellar nanocarriers: Improved chemical stability and enhanced skin deposition of anti-acne drugs

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Keywords: micelles, nanocarriers, benzoyl peroxide, clindamycin, tape stripping, topical drug delivery, anti-acne drugs, acne treatment

Introduction: Acne is a chronic inflammatory disease of pilosebaceous units, affecting approximately 85% of the population at various ages. Benzoyl peroxide is one of comedolitics frequently used in the treatment of mild and moderate acne. Clindamycin also used topically to kill the bacteria responsible for acne breakouts. The combination of comedolitic and topical antibiotic in the same topical formulation would provide high efficiency of treatment. But it has some stability problems. Particularly, benzoyl peroxide is not stabil in the presence of nucleophilic agents and acidic substances and benzoyl peroxide gel rapidly breaks down in a month in the presence of ethanol and acidic chelating agents at temperatures of 30-40 °C. Thus, it is kept in a cool temperature and mixed with clindamycin when it is used. The efficacy of topical acne treatment also depends on the deposition of drugs in the targeted layers of the skin. Polymeric micelles as nanosized drug carriers, have some superiorities such as improving solubility of hydrophobic drugs in the water, decreasing side-effects (irritation, etc.) of the drugs, keeping the drugs from environmental factors (oxidation, etc.), targeting of drugs into skin layers. The polymeric micelles would also accumulate in hair follicles and inflamed areas as polymeric nanoparticles.

Objectives: In this study, we aimed to decrease the side effects of benzoyl peroxide and to improve its stability by encapsulating it inside of micelles. We also investigated that the deposition of micelles loaded drugs in the skin layers and the accumulation of them in hair follicles.

Methods: The size, size distributions were characterized by ZetaSizer. The drug loading and drug solubility were determined by high performance liquid chromatography. The stability of these systems has been followed for three months under specific conditions. Skin permeation studies also performed using Franz diffusion cells with in vitro pig skin. Following skin permeation studies, the localization of drug in the skin the skin layers also examined using tape stripping method and confocal laser scanning microscopy.

Results: The results indicated the drugs were loaded to polymeric nano-sized micelles. The chemical stability of benzoyl peroxide has enhanced in polymeric micelles, data showed that it was more stable than free drug. The tape stripping data indicated that polymeric micelles accumulated in the hair follicles and didn’t pass through the skin. The confocal laser scanning microscopy studies also confirmed that findings.

Conclusions: Data obtained in this study indicated that the nano-sized polymeric micelles could be considered as effective drug carriers in terms of both the improvement of chemical stability of anti-acne drugs and the enhancement of drug deposition in the hair follicles for effective acne treatment.

O10

Integrating Non-Invasive Biophysical Analysis and Multivariate Statistical Modeling into a Comprehensive Framework for Cutaneous Injury, Wound Healing, and Treatment Efficacy Analysis

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Introduction: Cutaneous injury and healing progression may be defined with respect to the comprehensive effects of injury on a variety of skin biomechanical, cosmetic, physiological, morphological, clinical, immunohistological and histopathological parameters. The nature of these effects is governed by the injury modality and treatment regimen in question. Historically, cutaneous wounds were characterized using subjective (e.g., naked-eye observations) and/or destructive (e.g., immunohistochemistry or histopathology) observations. However, such observations failed to address functional parameters. Recently, advances in skin analysis have established a growing number of non-invasive biophysical (NIB) tools that enable researchers to objectively quantify skin biomechanical (e.g., ballistometry), cosmetic (e.g., colorimetry), physiological (e.g., evaporimetry), and morphological (e.g., image analysis and high frequency ultrasonography) properties. Yet no standardized framework for converting this complex multivariate information into useful clinical knowledge has been proposed.

Objectives and Methods: Inspired by the pioneering works of Karl Pearson (principal components analysis, 1901), Harold Hotelling (Hotelling Transform, 1933), Herman Wold (partial least squares regression (PLS, 1966), and other data scientists, we developed a novel computational method to comprehensively describe cutaneous vesicant injury, healing, treatment efficacy, and treatment-induced side effects as emergent constructs of NIB, clinical, and histological observations.

Results: We validated this approach in several wound healing studies evaluating short-term (2-week) and long-term (18-week) treatment outcomes of cutaneous sulfur mustard injury in Yorkshire and Sinclair miniature pigs. NIB assessments were more sensitive and reliable indicators of cutaneous injury than either histological or visually recorded clinical observations.

Conclusions: The growing number of tools for skin analysis has necessitated development of robust, objective, and data-driven computational methods capable of extracting useful information from increasingly complex data sets. We herein demonstrate that bidirectional orthogonal projection to latent structures (O2PLS) is a powerful multivariate algorithm for meeting this challenge in the wound healing arena.

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The views expressed in this abstract are those of the author(s) and do not reflect the official policy of the Department of Army, Department of Defense, or the U.S. Government.

The experimental protocol was approved by the Animal Care and Use Committee at the United States Army Medical Research Institute of Chemical Defense and all procedures were conducted in accordance with the principles stated in the Guide for the Care and Use of Laboratory Animals and the Animal Welfare Act of 1966 (P.L. 89-544), as amended.

This research was supported by the Defense Threat Reduction Agency – Joint Science and Technology Office, Medical S&T Division.

O11

Multimodal skin imaging to quantify treatment response in infantile hemangiomas

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Key Words:
skin, infantile hemangioma, ontogeny, objective measurement, infrared thermography, digital imaging, three-dimensional imaging, propranolol, timolol, infant

Introduction:

Infantile hemangiomas (IHs) are benign rapidly proliferating endothelial cell neoplasms vascular neoplasms that undergo rapid endothelial cell proliferation via angiogenesis and/or vasculogenesis shortly after birth, stablize, and slowly involute with diminishing cellular activity and fibrous fatty deposition for up to 5 – 7 years. They are classified as superficial, deep, or mixed based on the depth of dermal involvement. Clinicians typically evaluate IH status by visual inspection and photography for color, size, and shape, and by palpation for temperature and deformability. Physiologically-based objective measurements are important for determining the effectiveness of new treatments. Standardized digital photography, infrared (IR) thermography and three-dimensional imaging have been reported for assessing IHs. IR thermography is a reliable, noninvasive, low-cost technique to evaluate vascular function as surface temperature distribution is primarily affected by its depth within the tissue, tumor size and internal temperature from metabolism and perfusion. Thus, via heat conduction in the skin and blood flow (heat convection), IR surface imaging can be used to detect and characterize structures and activity related to the underlying physiology of IHs.

Objective:

We used multiple skin imaging methods, including three-dimensional (3D) surface scanning, high resolution color imaging, and infrared thermography to characterize IHs over time and in response to treatment among patients from the Hemangioma and Vascular Malformation Center (HVMC). These physiologically based methods were selected to correspond to tumor features evaluated clinically.

Methods:

A prospective observation clinical cohort study was conducted among 56 subjects with 64 hemangiomas. HVMC clinical practices standards were followed resulting in three treatment groups: oral propranolol, topical timolol or observational (untreated). The Institutional Review Board approved the protocol and parents/guardians provided written informed consent. Quantitative outcomes were height, volume, total region of interest (ROI) from the thermal image, size from the color image, lightness intensity, lightness area, red color intensity, red area, yellow color intensity, yellow area, thermal intensity, and thermal area. Maps representing the intensity and area distribution for lightness, red color, yellow color and thermal outcomes were generated. The relative change in IH color and thermal intensity were measured as the difference from a threshold selected to separate contributions from the unaffected skin. Color and IR images were co-registered and analyzed with a custom graphical user interface. The features of the surrounding uninvolved skin were removed by applying color and thermal thresholds to IH and contralateral control histogram distributions. The effects of time on IH by treatment were analyzed using two-way repeated-measures analysis of variance. The between-subjects factor was treatment and the repeated factor was time since start of treatment (or first observation for untreated hemangiomas), which was discretized into 2-4-month intervals. Post hoc t-type comparisons were made among treatment groups when significant ($p < 0.05$) treatment-by-time interactions were observed.

Changes over time were evaluated using univariate general linear models procedures (GLM) using the subject as a random factor.

Results:
The area of increased thermal activity for the hemangiomas, i.e., greater than that of uninvolved control regions, was markedly larger than the visually observed borders. On average, the area from the color image (and visual clinical assessment) was 35% of the thermal region of involvement (ROI). The ROI from the thermal image was used to analyze color outcomes.

Subjects in the untreated group were significantly older than the propranolol and timolol groups ($p < 0.05$), reflecting differences in treatment strategy. Over the 15 month period, significant changes ($p < 0.05$) were noted for propranolol treated IHs as follows: decreased height, increased lightness intensity, reduced lightness area of involvement, decreased IR thermal intensity, decreased red intensity, increased yellow intensity (decreased blue color), and decreased yellow area. Over time, significant changes were observed in untreated IHs as follows: decreased height, increased lightness intensity, reduced lightness area, decreased IR intensity, and decreased red intensity. For the timolol group, the only change over time was an increase in tumor height ($p < 0.05$). Significant treatment differences were observed. Reduction in tumor height was greater for propranolol versus timolol ($p < 0.05$). IHs treated with propranolol were lighter versus timolol ($p < 0.05$). Red area decreased for propranolol and untreated IHs compared to timolol ($p < 0.05$). The outcomes did not differ for propranolol versus untreated IHs. When the age difference between these groups is considered, the improvements occurred more rapidly for propranolol subjects.

Conclusions:
Multimodal real-time skin imaging techniques can quantify ontogeny/disease progression over time, differentiate treatment effects between propranolol and timolol, and provide intensity and area maps showing the regions of change within the vascular tumor. Structural features (e.g., size, color, topography) can be evaluated visually, but functional characteristics, such as temperature difference from normal skin and thermal area of involvement cannot be assessed by current clinical methods. Collectively, the imaging outcomes reveal information related to the underlying IH physiology and, thereby, extend the capability of clinicians.

O12

How to unravel the pathomechanism of sensitive skin. A systematic literature review

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INTRODUCTION: Despite sensitive skin being highly prevalent, no consensus on its definition and its pathomechanism exists. Here we report the results of a systematic literature review on diagnostic methods for sensitive skin at clinical, histological and biophysical levels. METHODS: A systematic search revealed 27 out of 1701 articles which we appraised in detail.

RESULTS: Impaired skin barrier function and increased vascular reactivity are most often associated with sensitive skin. We identified key reasons causing an ambiguity around the sensitive skin phenomenon.

CONCLUSION: We propose using standardized selection of subjects by a multifactorial questionnaire, spanning a range of provocations, including those of chemical, mechanical and environmental origin, followed by clinical, histological and top-notch biophysical measurements. This could lead to a break-through in the understanding of the sensitive skin phenomenon, fueling advances of biomedical and dermatological science.

O13

Polidocanol inhibits cowhage- but not histamine-induced itch in humans – further characterization of an experimental model of histamine-independent itch

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Key Words: itch, cowhage-induced itch, histamine-induced transepidermal water loss, visual analogue scale, erythema, wheal volume, flare size

Background and Introduction: Histamine plays a marginal role in many pruritic conditions. Histamine-independent itch models are crucial for the understanding of itch pathology and testing of antipruritic agents Cowhage spicules contain the cysteine protease, mucunain, which is released after insertion of the spicules into the skin, resulting in PAR-2 activation and the subsequent induction of itch. Polidocanol was demonstrated to be ineffective in histamine-induced itch.

Objectives: The study was intended to further characterize an experimental, histamine-independent, cowhage-induced model of pruritus and to test the antipruritic efficacy of topically applied polidocanol.

Methods: Ten healthy volunteers were challenged with histamine-skin prick testing (SPT) and cowhage spicules. Itch was assessed by use of a visual analogue scale. Skin erythema (Mexameter), transepidermal water loss (TEWL; Tewameter TM 300)), wheal volume, and flare size were measured. Topical polidocanol treatment was tested for its efficacy on cowhage- and histamine-induced itch in 45 healthy volunteers versus placebo.

Results: Polidocanol reduced cowhage-induced itch vs. placebo (area under the curve: 149 vs. 346, $p<0.05$; duration: 6.3 vs. 9.9 mins., $p<0.05$) but not histamine-induced itch. Skin erythema increased significantly after histamine-SPT (204 vs. 287 arbitrary units, $P<0.01$) but not after cowhage. TEWL and skin temperature after skin challenges were unchanged.

Conclusion: Cowhage induces histamine-independent itch without barrier alteration or induction of an inflammatory reaction. Polidocanol inhibits cowhage- but not histamine-induced itch, indicating the importance of histamine-independent itch models in the development of topical antipruritic agents.

O14

Modification of Skin Discoloration by Topical Treatments: the Effect of an Anti-oxidant.

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Estee Lauder Companies

Key words: hyperpigmentation, Dianella ensifolia, skin whitening

Introduction: Skin hyperpigmentation, and the reactions that precipitate it, has been linked to free radicals by the fact that free radical scavengers or antioxidants can slow that hyperpigmentation. We have screened several plant extracts for anti-oxidants and discovered one that is both a strong antioxidant and can reduce skin hyperpigmentation. Extract of Dianella ensifolia containing 1-(2, 4-Dihydrophenyl)-3-(2, 4-dimethoxy-3-methylphenyl) propane (DP), was found to be a strong anti-oxidant in vitro.

Objective: to investigated the effects of a formulation containing DP on skin hyperpigmentation.

Method: The reduction of discoloration by different topical treatments was assessed in human volunteers using an in vivo assay for the rate of fading of UVB-induced tan. Pharmaceutical formulas containing 4% hydroquinone (HQ) were used as positive controls, and we tested the ability of 1-(2, 4-Dihydrophenyl)-3-(2, 4-dimethoxy-3-methylphenyl) propane (DP), a plant-derived amphoteric antioxidant, to increase performance of non-HQ cosmetic formulations.

Result: We found that the cosmetic formula containing DP produced an increase in the rate of fading compared to the two pharmaceutical treatments containing HQ.

Conclusion: Extract of Dianella ensifolia containing strong anti-oxidant activity was extremely effective in lightening skin tan.

O15

Improved skin penetration and distribution of two antifungal compounds using new topical carriers

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Keywords: liposomes, transfersomes, ethosomes, naftifine, voriconazole, vesicular carriers, tape stripping, topical drug delivery, antifungal drugs, skin

Introduction: Many physical and chemical techniques have been aimed to overcome the barrier properties of the stratum corneum to enhance the drug transport across the skin. The use of new dermal carrier systems provides enhanced efficiency at the targeted skin layers and decreases the systemic side effects in cutaneous disorders. One of the most attractive methods is optimization of vesicle formulations as skin delivery systems. Ethosomes and transfersomes which are more elastic than the conventional liposomes can allow enhanced permeation through skin.

Objectives: In our study, liposomes, ethosomes and transfersomes were formulated, characterized and investigated for their ability to enhance topical delivery and cutaneous localization of an allylamine antifungal drug naftifine and a triazole antifungal compound, voriconazole in vitro and in vivo.

Methods: The size, size distribution, zeta potential, drug loading and interfacial behavior of the formulations were characterized. Skin penetration studies were performed using Franz diffusion cells with in vitro pig skin as the membrane. In vitro and in vivo tape stripping studies were performed to determine the drug compounds in different skin layers quantitatively. The localization of naftifine and voriconazole in the skin was examined using confocal laser scanning microscopy.

Results: The results indicated that transfersomes and ethosomes showed superior skin retention compared with liposomes. Tape stripping study and confocal laser scanning microscopy showed greater drug penetration and accumulation in the skin treated with transfersomes and ethosomes.

Conclusions: We conclude from our studies that transfersomes and ethosomes are promising vesicular lipid carriers for improved cutaneous localization of naftifine and voriconazole in the effective treatment both of superficial and deep seated dermal fungal infections.

O16

Assessment of skin surface roughness of 24 body sites – a validation study of a rapid in-vivo roughness measurement technique based on laser speckles

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Keywords: skin surface roughness, root-mean-square Rq roughness, aging, cosmetic dermatology, laser speckles, optical imaging technique, sun exposed sites, clinical study

Introduction: Roughness is an important property for aging, cosmetic dermatology and many skin conditions, including warts, actinic keratoses, psoriasis, and skin cancers. We developed a fast in-vivo imaging technique to quantify the root-mean-square Rq roughness of skin surfaces based on laser speckles, which are stochastic interference patterns generated when coherent light interacts with rough surfaces. Speckle patterns encode information regarding the light source, the targeted object and the geometry of the image formation process. We established a mathematical formulation to extract surface roughness from a speckle pattern, and constructed a portable device that consists of a blue diode laser and 2 CCD cameras. The integration time is approximately 5ms.

Objectives: The objectives of this study are to validate the sensitivity of the laser speckle roughness device, and to collect surface roughness data systematically among 24 body sites.

Methods: We conducted a clinical study, systematically measuring 24 body sites from volunteers who were recruited from advertisements at the Skin Care Centre, Vancouver General Hospital, Canada. The study was approved by the University of British Columbia Research Ethics Board, and all volunteers completed a written informed consent. Their self-reported age and gender, along with room temperature and humidity were recorded. After waiting in the examination room for a minimum of 10 minutes for acclimatization, the research assistant gently placed the speckle roughness device on the volunteer's skin with minimum pressure and acquired speckle images. The procedure was repeated for 24 body sites. Afterwards, speckle images were processed and the skin surface roughness was computed. The results were analyzed using repeated measure ANOVA with a Greenhouse-Geisser correction. Age, gender, room temperature and humidity were treated as covariates. The roughness of body sites was further analyzed according to gender specific sun exposure categories, with each body site being classified as minimally, intermittently or maximally sun exposed.

Results: Seventy-two volunteers (27 males and 45 females; mean age 38+/-14) were recruited. Preliminary analysis showed that male skin surface roughness was significantly rougher than female skin surface roughness, adjusting for humidity. When the body sites were categorized into minimally, intermittently or maximally sun exposed, the data revealed that the roughness of maximally sun exposed sites was significantly higher than the roughness of the other two categories. In addition, the speckle roughness agreed well with the skin Rq roughness values reported in the literature.

Conclusions: We conducted a large scale study systematically assessing skin surface roughness using our laser speckle roughness device. Our preliminary data showed that the measurements were in agreement with our notation of skin surface roughness and literature values; thereby suggesting that we have developed a fast and sensitive in-vivo technique for quantifying skin surface roughness.

O17

Development and Organization of Human Stratum Corneum After Birth.
Electron Microscopy Isotropy Score and Immunocytochemical Corneocyte Labelling as Epidermal Maturation's Markers in Infancy

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Key Words: skin surface topography, anisotropy, tape stripping, children, scanning electron microscopy, non-invasive, immuno-electron microscopy, corneodesmosomes

Introduction: Skin barrier function which resides almost completely in the stratum corneum (SC) is competent after birth of full term neonates under basal conditions with regard to epidermal permeability barrier function as measured by transepidermal water loss (TEWL). However, there is growing evidence for the on-going structural and functional adaptation of the skin after birth.

Objectives: The aim of this study was the definition of scanning electron microscopy markers of skin maturation in different age groups (birth to adulthood). We propose a semi-quantitative score analysing the skin surface maturation and a complementary evaluation of corneodesmosin/corneodesmosome distribution.

Methods: Investigations were performed in 6 age-groups including full-term neonates, babies, children and adults. The study was performed in two parts: the first one (study A) aimed at the development of a semi-quantitative score based on SEM-pictures from D-squames®. The second part (study B) served for confirmation and refinement of the method combined with corneodesmosome remnants analysis. The distribution of corneodesmosome remnants was analyzed by corneodesmosin distribution in immunocytochemical corneocyte labelling. The results obtained in both parts were used for comparisons between groups of different ages. Only healthy infants and adults with no present and/or past history of any skin disease were included.The studies were approved by the local authorities and by the Freiburg ethics commission international.

Results: E.M.I. score showed the highest anisotropy in neonates. The youngest groups displayed irregular and thick cell clusters composed of poorly individualised cells. In the older groups, distribution of superficial corneocytes was more regular. The cells evenly covered the surface and displayed easily visualised single cell outlines. Distribution of immune-labelled corneodesmosome remnants and the corneocyte projected area showed a correlation between age and structural maturation. The observed evolution indicated a poorly controlled process of corneocyte desquamation in infants and confirmed the relative immaturity of the epidermal barrier up to 1-2 years after birth under basal conditions.

Conclusion: Our study is the first attempt of semi-quantitative evaluation of the epidermal surface micro-morphology maturation at the ultrastructural level. E.M.I. score and the associated pattern of corneodesmosome breakdown may be used as markers of the stratum corneum maturation.

O18

Simultaneous measurement of epidermal barrier function with the new Triple-Tewameter Probe in healthy and atopic human volunteers

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Introduction: Assessing epidermal barrier function is usually performed by devices measuring transepidermal water loss (TEWL). Evaluating several spots in the same area e.g. with different cosmetic treatments or in clinically impaired skin with an altered epidermal barrier is time consuming. Measuring areas that are closely located to each other increases the clinical relevance of the obtained TEWL values.

Objectives: In the present studies we compared the new Triple-Tewameter TM 330T with three space-adjustable probes with three independent TM 300 probes regarding precision and reliability of the two TEWL-assessment systems.

Methods: The study was performed in 22 healthy volunteers and in 20 patients with atopy but not currently active atopic dermatitis. We assessed basal barrier function with three independent TM 300 probes and the new Triple Probe TM 330T with adjustable probe heads. To ensure that the skin physiology of our population was homogenously distributed we measured S.C. hydration (capacitance based Corneometer CM 825), erythema and melanin index (mexameter). All measurements were performed under standardized climatic conditions and after 15 minutes of adaptation. Additionally we induced different degrees of barrier insult by cyanoacrylate and tape stripping.

Results: The new TM 330T probe showed very precise measurement accuracy. The comparison of the two systems to assess epidermal barrier function (TM 300 and TM 330T) showed comparable results in terms of left-right arm correlation, speed of reaching steady state conditions (18 seconds for both systems) and overall correlation of the two systems on unchanged as well as on experimentally impaired epidermal barrier.

Conclusions: The new Tewameter probe TM 330T can be considered a reliable system that allows simultaneous measurements on three closely located areas. The new system is comparable to the established TM 300. However a change from one system two the other should not be performed within an ongoing study.

O19

Dynamic Drying Mechanics of Human Stratum Corneum and the Effects of Moisturization

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Keywords: Drying, Stratum corneum, moisturizer, tissue mechanics

Introduction: In the presence of pathological skin conditions or with aggressive cleansing, lipids and natural moisturizing factors that are ordinarily found in healthy tissue can be damaged or depleted. This can lead to a loss of barrier integrity, increases in trans-epidermal water loss and the onset of stiff, dry and brittle xerotic skin that is more likely to crack and chap. We have previously demonstrated that cleansing using a variety of different surfactants can cause dramatic changes to the mechanical properties of stratum corneum. In some cases, cleansing can lead to an order of magnitude increase in elastic modulus and drying stress. We expect that these mechanical properties have a direct impact on cracking and chapping of skin as well as the milder sensation of perceived tightness often experienced after washing. Glycerol, a common humectant found in many moisturizers has been shown to improve skin hydration, reduce drying stresses in the barrier and accelerate recovery of barrier integrity. We are investigating the impact of treatment with low concentration of aqueous glycerol solutions on the changes in the mechanical properties and drying behavior of healthy and barrier damaged stratum corneum.

Objectives: Our research aims to quantify the efficacy of low concentrations of aqueous glycerol solutions on reducing drying stresses and barrier stiffness in both healthy and damaged stratum corneum.

Methods: We employ a high-throughput method capable of rapidly quantifying the mechanical properties and drying mechanics of ex-vivo samples of human stratum corneum adhered to soft deformable elastomers. Spatially resolved deformations in circular tissue samples are measured repeatedly during drying in controlled environmental conditions. Deformations are azimuthally averaged and fit with a profile based on a linear elastic model. We extract spatially resolved drying deformation fields from the fluorescent images using a standard particle image velocimetry algorithm compares average drying deformations at the edge of delipidized stratum corneum samples with delipidized stratum corneum samples treated with 2% and 5% glycerol over a 6 hr drying period. Healthy stratum corneum samples washed only in deionized water are compared with glycerol treated healthy stratum corneum samples. Dynamic changes in the drying deformations, elastic modulus and osmotic drying stress of the stratum corneum are then extracted.

Results: Barrier damage caused by delipidization causes dramatic increases in drying deformation magnitude and growth rate over the first 30 minutes in comparison with healthy stratum corneum. Subsequent treatment with glycerol slows deformation growth rates and reduces deformation magnitudes after complete drying (~2h). This suggests a reduction in the rate of water loss and a higher retention of water. Glycerol treatment of healthy stratum corneum notably reduces drying deformation magnitudes relative to samples only washed in water. 5% glycerol treated samples have less drying deformation than 2% glycerol treated samples for both healthy and delipidized stratum corneum. We further extract values of stratum corneum elastic modulus and osmotic contractile drying stress over time by fitting deformation profiles with a linear elastic model. One hour treatment with a low concentrations of aqueous glycerol solutions reduce both the elastic modulus and the build-up of drying stress in comparison with stratum corneum washed only in deionized water for an equivalent time.

Conclusions: This approach enables the rapid comparison of drying mechanics in healthy and damaged tissue as well as the effects of treatment with low concentrations of glycerol on drying behavior.

O20

Confocal Microscopy and Characterization of Mechanical Properties of Human Skin

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Keywords: Reconstructed Skin, Human Skin ex-vivo, Mechanical Properties, Experimental Device, Confocal Microscopy, Image Correlation.

1. Introduction

Skin tissue engineering has become an important field of research for medical and cosmetic applications. Most of biomimetic skin models have been validated regarding their histological and biochemical properties; their mechanical responses are however scarcely studied and far from that of the native tissue.

According to the complex structure of skin, its mechanical behavior is mainly linked to the dermis structure. The fibrillar network, made of crosslinked collagen and elastin fibers, acts for resistance and elasticity whereas the surrounding medium of hydrated proteoglycans confers to the skin its viscosity.

2. Objectives

The aim of this work is to develop mechanical experimentations to assess the mechanical properties of ex-vivo or reconstructed skin. The global mechanical behavior of these samples is studied with indentation and relaxation tests. And the local mechanical behavior is quantified in coupling a mechanical stress and the internal visualization of the sample with bi-photonic confocal microscopy. The experiments are currently validated using skin biopsies.

3. Methods

An original light-load indentation device has been designed. The maximum force can reach 100 mN with a resolution of 0.02 mN. It offers a displacement with a resolution of 1 µm and indenting velocities from 1 to 100 µm/s. Indentation parameters were 1 mN for maximum force and 25 µm/s for the indentation velocity.
The developed device can also perform relaxation test, with 1mN of maximum force, an indentation velocity of 50 µm/s and a latency time of 80 s.

Skin samples have been observed using a bi-photonic confocal microscope. Stacks of 100 images of 1024x1024 pixels each have been recorded.

Combining the confocal microscope with a micro-traction device makes it possible visualization of the internal network of collagen and elastin under stretching. The behavior of the fibers during traction was analyzed thanks to image correlation. The traction parameters were a traction velocity of 2 mm/s and steps every 10 % of deformation.

All the experiments have been performed on 20x10 mm skin biopsy samples obtained from plastic surgery of woman breast.

4. Results

Indentation and relaxation measurements have been correlated with rheological models (Hertz and Maxwell models) to estimate visco-elastic properties of the skin biopsy samples. The elastic properties in the tangential direction have been

obtained with the traction test. The structure of the skin biopsies has been observed using bi-photonic confocal microscopy. The collagen fibers and the elastin fibers have been observed simultaneously, using second harmonic generation auto-fluorescence, respectively. Moreover, it was possible to follow the state of the network of collagen and elastin during traction test. Image correlation gave us displacement fields between each step of traction test.

5. Conclusions

We have developed a unique experimental tool that allows assessing the mechanical properties of human skin in normal and tangential directions. These assessments are coupled with a good understanding of the organization and the deformation of the internal network.

O21

Control of nuclear deformability by lamins: implications for cancer cell invasion into skin-like tissue environments

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Key words: Cell Migration, Collagen, Skin, Skin-Related Tumor, Lamin, Cell Deformability, Atomic Force Microscopy

Introduction: The interstitial connective tissue of the skin contains three-dimensional meshworks of collagen of heterogeneous structure and porosity serving both as guidance structure and as a barrier for the migration of normal and neoplastic cells. After tumor initiation malignant cells start to invade connective tissue sites, which requires cell deformation to transmigrate available tissue pores of varying sizes. Such adaptation is determined by the mechanical flexibility of the nucleus, the largest and stiffest cell organelle. Nuclear stiffness, stability and shape are maintained by the nuclear lamina consisting of A- and B-type lamins; and it is established that A-type lamins, together with the chromatin state, determine the stiffness (reciprocal: deformability) of the nucleus. To date it, however, remains unclear whether lamin-mediated nuclear rigidity limits cellular adaptation during migration through confining spaces of 3D connective tissues, and to what extent individual lamins are rate-limiting during this process.

Objective: The aim of this research is to investigate the role of lamin-mediated nuclear rigidity during cell migration through confining spaces by both up- and down-regulation of lamin A- and B- subtypes.

Methods: Transient RNA-interference, or stable overexpression of A/C, B1 and B2-type lamins were induced in HT1080 fibrosarcoma and MV3 melanoma cells. Cells were characterized for lamin expression by western blotting and fluorescence microscopy. Lamin distribution and nuclear shape changes among different cell lines and conditions were examined by confocal microscopy. Cell migration in relatively dense 3D collagen lattices was monitoring by time lapse microscopy and quantified by computer-assisted cell tracking. Transwell chamber assays using membranes of 3, 5 and 8 um pore diameters were used to study transmigration rates. AFM measurements are applied to measure nuclear flexibility and deformability.

Results: Transient and stable knockdown, as well as stable overexpression of lamins were found to modify both nuclear deformability as well as migration rates of cancer cells. Knockdowns of A- and B-type lamins were associated with increased nuclear deformability and migration rates. Lamin overexpression resulted in somewhat irregular lamin deposition and nuclear shape, in association with lower nuclear deformability and migration rates through collagen of confining pore sizes not, however, when spaces matched the cellular diameter. Further, transmigration assays confirmed our 3D collagen migration rates.

Conclusion: The data indicate a biomechanical lamin-dependent mechanism of nuclear shape adaptation during cell migration through confining skin-like connective tissue equivalents, with implications on the efficacy of cancer cell invasion through skin-like interstitial tissues.

O22

Evaluation of RSDL and measurement of VX depth profiles in hairless guinea pig skin using confocal Raman microspectroscopy

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Key Words: VX, nerve agents, confocal Raman microspectroscopy, hairless guinea pig, Reactive Skin Decontamination Lotion

Introduction: The nerve agent VX is a potent organophosphorous compound that is extremely toxic. The River Diagnostic's Raman Skin Analyzer uses a specially designed microscope objective to focus low power laser light into the skin. Noninvasively and in real-time, the scattered light is collected to a depth of about 100 µm with an axial resolution of approximately 4 µm.

Objective: This study used confocal Raman microspectroscopy to investigate the fate of percutaneously applied VX in the upper skin layers of hairless guinea pigs and also to determine the ability of a new skin decontamination product, Reactive Skin Decontamination Lotion (RSDL), to remove VX from the skin surface and from a depot that had formed below the skin surface.

Methods: Anesthetized hairless guinea pigs (250-400 g) were exposed to neat VX (0.3 µl, 15 x LD50) using a specially designed template that allowed repeated Raman measurements on the same skin location. Animals were given a bioscavenger to protect against signs of VX toxicity. Raman depth profiles were recorded preexposure, at various times postexposure, and following decontamination with RSDL. Animals were euthanized no later than 48 hr postexposure. After euthanasia, exposure site skin punches were collected and analyzed for VX.

Results: VX was observed to form a depot in the stratum corneum, 0 – 20 µm deep, in about 30 minutes postexposure. This depot decreased with time but was still detectable at 48 hr postexposure. RSDL was observed to remove VX from both the skin surface and the depot below the skin surface.

Conclusions: Confocal Raman microspectroscopy is an effective tool to obtain real-time, non-invasive analytical data on the concentration of chemicals in the upper skin layers. RSDL effectively removes VX from the skin surface and from the depot formed in the upper skin layers following percutaneous exposure.

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The experimental protocol was approved by the Animal Care and Use Committee at the United States Army Medical Research Institute of Chemical Defense and all procedures were conducted in accordance with the principles stated in the Guide for the Care and Use of Laboratory Animals and the Animal Welfare Act of 1966 (P.L. 89-544), as amended.

This research was supported by the Defense Threat Reduction Agency – Joint Science and Technology Office, Medical S&T Division.

O23

Nanoscale infrared spectroscopy and imaging of structural lipids in human stratum corneum cross sections

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Key words: infrared microspectroscopy; IR; atomic force microscopy; AFM; stratum corneum; cross-sectional imaging

Introduction

Infrared (IR) spectroscopy is a powerful tool for obtaining chemical information related to a material. Unfortunately, the wavelength of light used to make the measurement limits the size of structures that can be reliably identified by IR spectroscopy. Diffraction typically limits the spatial resolution of IR microspectroscopy to 3-10 µm, making this technique problematic for identifying small structures samples such as tissue sections. Atomic force microscopy (AFM), on the other hand, provides exquisite spatial resolution (as small as one nanometer), but this technique does not provide any chemical information. In this paper, we a new technique which combines AFM and IR in order to provide more chemical information about the location of structural lipids in stratum corneum cross sections.

Objectives

The main aim of this study is to demonstrate how the new methodology of AMF-IR spectroscopy and imaging can be used to provide unprecedented insights, through higher spatial resolution and chemical specificity, into the location of lipid components in stratum corenum cross sections.

Methods

Recently, AFM and IR spectroscopy have been combined in a single instrument capable of chemical identification of structures less than 100 nm in size. This instrumentation uses a pulsed, tunable, IR laser source to excite specific molecular vibrations in sample cross sections of human stratum corneum. The AFM cantilever tip acts as a small aperture IR detector of the thermal expansion of the sample that occurs when a particular wavenumber of IR radiation is absorbed at a specific location much smaller in size than the laser spot size and wavelength of the exciting IR radiation.

Results

Image ratios collected with the IR laser source tuned to the specific wavenumber where the lipid component absorbs strongly (2930 cm-1), divided by images collected with the source tuned to a protein IR absorbance band (3290 cm-1), show the location of structural lipids in the specimen.

Conclusions

The location of structural lipids in cross sections of human stratum corneum have been imaged by IR nanospectroscopy and shown to accumulate at the perimeter of corneocytes. This work suggests that future AFM-IR studies may prove useful for understanding penetration pathways through the stratum corneum of specific ingredients in topically applied drugs or skin care products.

O24

The development and validation of Skin Damage Area and Severity Index to access sliding induced skin injuries on artificial turf

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Keywords: football, artificial turf, skin injury

Introduction: Injury prevention is an important reason for the development of performance standards in football (soccer). At the moment the abrasiveness of football pitches are evaluated by test methods using skin replacers. Although reproducible the major short coming of these tests is that they do not simulate the response of in vivo human skin and its biology. Currently, there is no suitable objective method available to quantify the severity of a sliding induced skin injury which correlates with the perceived discomfort of artificial turf pitches.

Objectives: To develop a non-invasive method for quantification of the observed sliding induced skin damage and evaluate whether there is a correlation between the subjective perceived skin irritation and sliding friendliness.

Methods: Previously obtained clinical images of sliding induced skin lesions where rated by a dermatologist on the degree of abrasion, erythema and type of exudation. In line with the Psoriasis Area and Severity Index (PASI), which is a dermatological tool to measure the severity of Psoriasis, a Skin Damage Area and Severity Index (SDASI) is proposed to characterize sliding induced skin lesions. To test the practical feasibility of this proposed index a randomized user trial with nine amateur football players was carried out. The sliding friendliness of three different grades of infill materials was tested.

Results: The SDASI correlates both with the perceived skin irritation ($r=-0.53$, $P=0.02$) and sliding friendliness ($r=-0.58$, $P=0.01$).
Statistical analysis of the individual clinical scores showed that perception of skin irritation and sliding friendliness correlate very well with the degree of erythema and abrasion. However, these scores are independent of the size of the lesion and type of exudation. There were no statistical significant differences found between the three evaluated types of infill and their sliding performance.

Conclusions: This study demonstrated that the SDASI, which is a tool for quantification of a sliding induced skin lesion, correlates very well with the perceived skin irritation and the sliding friendliness. In the future, the scoring system can be used to refine the current injury monitoring assessment system with regard to skin injuries. The method can also be used to classify the sliding performance of current or newly developed football pitches.

O25

A Retrospective Study Evaluating the Use of a Probiotic Combined with Zeaxanthine on Acne Lesions and Post Inflammatory Hyperpigmentation

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Background

It is evident that gut microbes and oral probiotics could be linked to the skin, and particularly acne severity, by their ability to influence systemic inflammation, oxidative stress, glycemic control, tissue lipid content, and even mood. Probiotics combined with anti-inflammatory may be considered a therapeutic option or adjunct for acne vulgaris by providing a synergistic anti-inflammatory effect.

Methods

As part of a larger randomized clinical trial evaluating photo damaged skin, twenty subjects were randomized to receive probiotic and the anti-inflammatory Zeaxanthine capsules (a multi ingredient capsule including 30 mg of zeaxanthine) to be taken twice a day for 12 weeks. Cleansers, moisturizers and SPF were standardized. Clarity images were obtained and analyzed with proprietary software (BTBP San Jose CA, USA) at baseline and weeks 2, 4, 8 and 12. The parameters active lesions, p. acnes, post inflammatory hyperpigmentation (PIH) lesion count and visibility were analyzed.

Results

Although not the primary indication or studied on the group of interest, significant reductions in all study parameters over twelve weeks of use was shown in this retrospective analysis. Graphs 1, 2 3 and 4 show the reductions over time.

Conclusions

These data add to the evidence that Probiotics combined with Zeaxanthin may be considered for future research in the target population and in disease specific subjects as a therapeutic adjunct.

O26

Effect of a test cream on irritant hand dermatitis in health care workers

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Key Words: stratum corneum, skin barrier, skin integrity, irritant hand dermatitis, TEWL, hydration, digital imaging, dryness, erythema, health care worker

Introduction

Routine hand hygiene reduces hospital acquired infections. However, repetitive hand hygiene is a significant factor in the development of irritant contact dermatitis in health care workers (HCW). Damaged hands have higher bacterial counts and increased susceptibility for penetration by irritants and microorganisms. Maintenance of skin integrity is protective for patients and workers.

Objective

The objective was to determine the effects on hand skin condition of a test cream, designed for moisture barrier repair and substantivity, relative to the hospital provided lotion among intensive care HCWs in a monitored use study.

Methods

Sixty-three subjects participated in the randomized controlled parallel group design using a combination of water based cleansing and alcohol hand rubs. Assignment to the test cream or hospital lotion was stratified by baseline knuckle dryness scores with 3x daily application. The primary outcome was skin condition measured after one, two and four weeks as expert visual scoring of dryness and erythema, digital imaging and analysis, stratum corneum integrity (TEWL) and skin hydration (capacitance). Levels of natural moisturizing factor were measured after four weeks of treatment from tape strips taken from the dominant hand knuckle and analyzed using FTIR imaging spectroscopy. Data were analyzed using linear mixed models with repeated measures.

Results

There was significant irritant dermatitis at baseline as over 60% of HCWs had knuckle dryness and erythema scores ≥ 2. Mean daily usages were 4.5 and 4.8 times for test and hospital lotion, respectively. After 4 weeks, hands treated with the test cream had lower dryness on the knuckles and dorsum of both hands ($p < 0.05$) as well as lower erythema on the knuckles of both hands ($p < 0.05$) versus the hospital lotion. Skin treated with the test cream had a more competent stratum corneum barrier, as evidenced by lower TEWL than that of the hospital lotion group ($p < 0.05$). For the test cream and hospital lotion, respectively, TEWL values were 26.2 and 21.6 g/m2/hr at baseline and 21.6 and 25.6 g/m2/hr at week 4. Hand skin of the test cream group was more hydrated, as evidenced by higher corneometer readings, than the hospital lotion group for both dorsum and the left hand knuckles ($p < 0.05$). The level of natural moisturizing factor was significantly higher at the dominant hand knuckle site for the test cream versus the control after four weeks of treatment in the selected subset ($p < 0.05$).

Conclusions

Application of the highly substantive test cream 4-5 times daily for four weeks significantly reduced the severity of irritant contact dermatitis in HCWs. Treatment with the test cream resulted in significantly lower measures of skin condition compared to the control of the hospital supplied lotion at work and the HCWs own skin products at home. Reduced skin compromise was evidenced by lower dryness for the knuckles and dorsum of both the right (dominant)

and left hands and lower erythema for the knuckles and dorsum of the knuckles of both hands and the left dorsum. Significantly lower TEWL values for the test cream versus control for all four regions (left and right knuckles, left and right dorsum) compared to the control indicate increased barrier integrity for the test cream. Skin hydration was consistently higher for all sites for the test cream. Levels of natural moisturizing factor were higher at the dominant hand knuckle site among a subset of HCWs suggesting that treatment with the test cream facilitated SC hydration relative to the control.

O27

Using the digital camera as a transducer for assessment of the skin

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Keywords: Digital camera, microcirculation, sweat gland activity

Introduction: Since advanced digital cameras were introduced in the 1990s, these devices have developed quickly and are increasingly used as transducers of advanced imaging systems in a variety of medical and other applications.

Objectives: The objective of this paper is to draw attention to some of the possibilities and pitfalls when using the digital camera as a transducer for non-invasive and remote assessment of skin parameters.

Methods: The digital camera utilizes a 2D sensor array for converting impinging visible light into electrons. Color filters can be integrated onto the 2D sensor array, thereby making it possible to separately record light within the red, green and blue wavelength bands. Eventually the three image matrixes generated by light within these wavelength bands are combined to form a true color photo. The color representation of this photo is dependent on the spectral profile of the light illuminating the object, the wavelength-dependent absorption and scattering properties of the object and the spectral profile of the sensor array. If the illuminating light source is kept constant (excluding ambient light), the absorption and scattering properties of the object under study can be quantitatively determined. Furthermore, polarizing filters can be positioned in front of the illuminating light source and the sensor array respectively, to modulate the average detection depth. For a semi-transparent object such as the human skin, the depth sensitivity can be altered by operating the system in co- or cross-polarized mode. Specific chromophores such as the hemoglobin molecule in the red blood cells demonstrate predominant absorption in the green and blue wavelength bands, and the presence of such chromophores can therefore be detected by analyzing the individual pixel values of the red, green and blue matrixes.

Results: Visible light penetrates the skin to an average depth of about 0.5 mm before re-emerging from the skin surface. A cross-polarized filtering configuration increases this average detection depth by about 0.1 mm while effectively filtering out specular reflection from the skin surface. This detection scheme is well suited for investigation of sub-epidermal objects such as the skin microcirculation structure. Alternatively, a co-polarized filtering configuration will detect primarily backscattered light from single scattering events that occur directly on the skin surface. While the linear polarization of this light from the skin surface is preserved, the re-emergent light is predominantly depolarized as a result of numerous photon scattering events that occur within the tissue. This resulting backscattered light is effectively blocked by the co-polarization filter in front of the detector array. When used in conjunction with a high resolution detector array, this mechanism is well suited for capturing such events as the appearance of sweat droplets on the skin surface. The high spatial resolution of digital cameras (in practice up to 18 mega-pixels) and the high temporal resolution of digital video (in practice up to 30 frames per second), make it possible to simultaneously investigate spatial and temporal events in the skin. Unlike methods based on the detection of time variable phase shifts of laser light scattered in moving blood cells (laser Doppler and laser Speckle imaging), polarization spectroscopy is not compromised by movement artifacts. As a result, skin microcirculation images can readily be captured and quantified in moving objects.

Conclusions: The digital camera can be used as a versatile transducer for assessment of a variety of skin parameters, such as red blood cell concentration in the microcirculation, sweat gland activity, and changes in skin and hair stubble properties over time. Possible confounding factors associated with differences in ambient light conditions, the spectral profile of the illuminating light, and spectral sensitivity of the camera detector array require the use of methodologies such as photo conversion by color matrix transformation in order to make the results obtained under different conditions and by different camera devices comparable. The technology can be implemented using desktop or laptop

computers for scientific laboratory investigations and on tablet computers for point-of-sale imaging of skin microcirculation in retail shops.

O28

Multi-scaling 3D measurement of the skin face & body

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Keywords: 3DScanner, Skin ageing, Skin care, Depth, area, Volume, Ageing signs, Density, Fringe projection, Face & Body.

Introduction: Anti-ageing & Skin care product are acting at different level of the skin producing some changes which can be measured on the surface or in the surface using different measuring techniques like Fringe projection and confocal microscopes. In the skin, the scaling of the evaluation of changes are mostly in the scale of cells from micron to millimetres while on the surface, it was obvious to start measuring small effect and therefore use micron to millimetre scaling as well. But cosmetics effect wish to give also perception effect which is related to the eye perception and in this case the scale is more in the millimetre to meter range.

Objectives: The technology of 3D scanner improved in the past years to provide high resolution measurement on a larger scale. It becomes interesting to compare measurement which can measure locally to assess wrinkles , fine lines and skin texture while assessing as well the full face perception looking at most of wrinkles, fine lines & folds.

Methods: New generation of 3D scanner technology combine the well-known fringe projection technique with stereometry. This overcomes some limitation due to Fringe projection itself and other from stereometry itself. It is possible to use high resolution camera (up to 16 Mpixels) and project fine fringes without problems.
Associated with a dedicated positioning bench, the 3D scanner can capture in 2 shots the complete face, merging left and right side and start analysing all well know areas of ageing on this face. Powerful algorithms will align, merge and extract all these areas automatically and calculate depth, length, volume, areas and more. New algorithm can also provide unique evaluation of fines line, wrinkles and folds perception by given a density of these features on the face.

Results: Studies were conducted based on different Field of views available on the scanner. The most relevant FOVs are the 160 (75% of the face) and the 250 for the full face. Results will show that multiple areas on the face can be addressed from the same measurement while the sensitivity of the new algorithm over the age show a new way of assessing wrinkles, folds and fine lines. We will illustrate also the capability of this multiScaling scanner to address morphology changes on body parts like Leg, haunch etc..

Conclusions: MultiScaling 3D scanner open new possibilities to address local and global evaluation of the skin ageing sign on the face and body part. New algorithm also open ways of evaluating cosmetics efficacy, closer to perception when it comes to be global. Sensitivity of these technologies is enough to see small changes, relevant from cosmetic effect.

O29

Clinical application of refractive index radiology

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Keywords: normal tissue, disease, phase contrast X-ray

1. Introduction

I present experimental evidence that synchrotron hard X-ray is suitable for radiological imaging of biological samples down to the cellular level. To investigate the potential of refractive index radiology using unmonochromatized synchrotron hard x-rays for the imaging of cell and tissue in various diseases.

2. Methods

Paraffin and formalin fixed tissue blocks were cut in 3㎜ thickness for the x-ray radiographic imaging. From adjacent areas, 4㎛ thickness sections were also prepared for hematoxylin-eosin staining. Radiographic images of dissected tissues were obtained using the hard x-rays from the 7B2 beamline of the Pohang Light Source (PLS). The technique used for the study was the phase contrast images were compared with the optical microscopic images of corresponding histological slides.

3. Results

Radiographic images of various diseased tissues showed clear histological details of organelles in normal tissues. Most of cancerous lesions were well differentiated from adjacent normal tissues and detailed histological features of each tumor were clearly identified. Also normal microstructures were identifiable by the phase contrast imaging. Tissue in cancer or other disease showed clearly different findings from those of surrounding normal tissue.

4. Conclusion

For the first time we successfully demonstrated that synchrotron hard x-rays can be used for radiological of relatively thick tissue samples with great histological details.

O30

Skin stiffness assessed in vivo using 20 mhz ultrasound shear wave elastography: age-related effects

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Keywords: Aging, Biomechanical properties, Noninvasive methods, Ultrasound elastography

Introduction

20-MHz ultrasound shear wave elastography is a new direct method for measuring in vivo the biomechanical properties of the dermis which overcomes bias issues induced by upper and inner skin layers encountered with devices such as the Dermal Torque Meter (DTM) or the Cutometer.

Methods

100 female volunteers divided into 4 age groups, [18-26, n=25], [34-42, n=25], [50-58, n=25], and [66-74, n=25] have been enrolled in this monocentric open clinical study performed at the St Louis Hospital in Paris. Measurements were conducted on the volar and dorsal forearm. Clinical assessment was done through the folding quotation induced by the Densiscore. DTM measurements (guard ring 1 mm) and ultrasound elastic maps of the dermis (Supersonic Imagine, Aixplorer®)) were then acquired.

Results and Discussion

As reported in previous studies, aged skin is characterized by less numerous and deeper folds with the Densiscore. DTM values showed a decrease of the immediate extensibility Ue and a decrease of the elastic parameter Ur/Ue which can be interpreted as a stiffening at high strain. On the contrary, shear wave elastography indicated a decrease of skin stiffness with age, which can be interpreted as a loss of stiffness at small strain.

These apparent opposite results open a new insight on our understanding of the biomechanical properties of the skin, and more precisely its non-linear properties. Results will be analyzed through the impact of 3 main components: collagen content and its 3D organization, and skin tension which is also assumed to be of primary importance.

Conclusion

Direct measurement of dermal biomechanical properties at low strain by 20-MHz ultrasound elastography is a rapid method which brings new insights of the skin biomechanical state. Ongoing developments aim to improve the spatial resolution of mechanical maps in the dermis.

O31

Assessment of human skin mechanical tension by local no contact impact and surface wave propagation analysis: ageing and gender effect

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Keywords: Human skin in-vivo, Ageing, Gender, Mechanical behavior characterization, Rayleigh surface wave propagation, Viscoelastic properties.

Introduction

The longevity of life is a recent unsurpassed demographic phenomenon in the history of the humanity and impact of which will be considerable. The analysis of ageing of populations and its social consequences requests an interdisciplinary approach. By gathering capacities of research in these different domains, it becomes possible to treat in a transverse way the big questions linked to ageing and to longevity, by understanding better all the factors that drive to the fragility of the old tissues (origin of diseases, of dysfunctions and handicaps).

Several methods of characterization of the mechanical behavior of human skin have been developed for several years. Most of these methods are based on physical contact between the measuring instrument and the skin surface, and the measured parameters are phenomenological and often does not allow to quantify the elastic constant as the elastic modulus, the viscosity and the anisotropy of mechanical tension during aging. In this work, we propose an innovative approach based on a dynamic measurement without physical contact with the skin tissues. The strategy is based on measuring skin response to an impact by a controlled air stream and surface wave propagation.

The new device developed has been used for the analysis of the evolution of the cutaneous tension during chronological aging and the characterization of the gender effect.

Objectives

It is the objective of this research to:

- Studying the evolution of skin mechanical behavior in vivo in different classes of age.
- Study the effect of gender on skin mechanical properties during aging.

Methods

For our non-invasive instrumentation, solicitation is a precise air blast pulse. It is used as controlled mechanical palpation to generate an oriented surface wave propagation. The monitoring of the local deformation and the generated surface wave propagation are measured by an optical measurement tools.

The skin viscoelastic behavior, is estimated following two approach: the first one for the local behavior of skin by analyzing its local response, and the second one for global behavior by analyzing the surface wave propagation speed.

The local behavior is modelled as longitudinal mechanical impedance represented by a dynamic single degree of freedom vibratory system (Mass-Spring-Damper). The basic elements (stiffness and damper) of the proposed system are estimated to testify to the local viscoelastic behavior of human skin in-vivo.

The obtained wave propagation assesses the free transversal mechanical impedance of the human skin through its structure. Considered as a surface Rayleigh wave, this wave is the signature of the dynamic energetic behavior human

skin. Related to a rheological model, the estimated surface Rayleigh wave propagation speed and its attenuation reflect the distribution of the viscoelastic mechanical properties in the human skin structure.

To validate the efficiency of the developed approach and its sensitivity, we exploit the variability and the evolution of the mechanical properties under ageing and gender effects. This approach based on wave propagation is also used to estimate the effect of natural cutaneous tension and the mechanical anisotropy of human skin.

Results

For a statistical study, the developed approach validated on Caucasian population of 80 healthy subjects. Subjects cover the age range of 22 to 65 years old, over 5 classes and for the two genders. Obtained measurement results are on the right forearm.

The evolution of all the mechanical parameters values decrease exponentially according the age for the tow genders. We have observed also that the deference between genders can be seen by a loss of mechanical properties of the female group representing 15 to 30 %, compared to the male group.

The results concerning the surface wave propagation speed, show a clear difference between the younger and older male groups (3m/s ±0.4 for the young group and 1.3 m/s±0.3 for the old). Effect of gender was marked by a decrease in the wave propagation speed of 20% for the female group.

Conclusion

Palpation of human skin by no contact impact measurement and surface wave propagation, were used as markers to quantify the evolution of the cutaneous tension and gender effect. The results show clearly the loss of tension differently between men and women during chronological aging.

O32

Biomechanical properties of pediatric skin and infantile hemangiomas

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Key Words:
skin, infant, infantile hemangioma, biomechanical properties, elasticity, deformation, elastic recovery, objective measurement, ontogeny

Introduction:

Infantile hemangiomas (IHs) are relatively common benign vascular neoplasms occurring in up 12% of infants. They are benign vascular neoplasms that appear shortly after birth and undergo rapid growth via endothelial cell proliferation for 8-18 months, followed by a stabilization period, then slow involution with diminishing cellular activity over months or years. They are more common in females and 60% are on the head and neck. Up to 24% develop life- or function-threatening complications require treatment by multi-disciplinary specialist teams. Complications include ulcerations, hemorrhage, infection, heart failure, vision impairment, airway obstruction, interference with feeding, and disfigurement. IHs are classified as superficial, deep or mixed based on dermal involvement and exhibit wide heterogeneity. Superficial IHs are bright red, slightly elevated and non-compressible. Deep IHs are soft, warm slightly bluish and may proliferate for up to 2 years. Most IHs are both superficial and deep. IHs are diagnosed by history and examination of size, color, growth stage, depth, tactile characteristics, and morphologic subtype. Clinicians palpate the lesions to determine rigidity and evidence of fibrous fatty tissue that infiltrates as the lesions involute.

Objective:

The objective was to quantify the tissue response to mechanical stress, i.e., suction, by measuring the biomechanical properties of infantile hemangiomas relative to a contralateral site of normal, uninvolved skin and to evaluate changes with disease progression.

Methods:

A prospective observational study was conducted among eighty patients with eighty-eight IHs less than five years of age at the time of clinic visits to the Hemangioma and Vascular Malformation Center. Treatments were prescribed according to clinical practice standards and in collaboration with the family. The Institutional Review Board approved the protocol and parents/guardians provided written informed consent. Tissue mechanical properties were measured with a Cutometer 575 (Courage & Khazaka electronic GmbH, Koln, Germany). Measurements were made with a 6-mm probe aperature. Two hundred mbar of negative pressure was applied to the IH and control sites for two seconds, followed by a two second relaxation period. The properties of the IHs were compared to the contralateral controls with univariate general linear models (GLM) procedures with depth, body site, and treatment as a covariates with a $p < 0.05$ significance level. The properties as a function of clinical classification (i.e., proliferating, stable or involuting) and the effects of age on the control site alone were evaluated with GLM procedures.

Results:

There were significant differences between the IH and contralateral control ($p < 0.05$) for each of the following: total deformation (Uf, higher for IH), residual deformation (R, higher for IH), overall elasticity (Ua/Uf, lower for IH), net elasticity (Ur/Ue, lower for IH), biological elasticity (Ur/Uf, lower for IH), total recovery (Ua, lower for IH), elastic deformation (Ue, higher for IH), elastic recovery (Ur, lower for IH) and viscoelastic creep (Uv, higher for IH). Significant differences ($p < 0.05$) were also observed as a function of disease progression. Total deformation was higher for IHs in

the involuting phase versus proliferation and stable. Viscoelasticity (Uv/Ue) was lower for involuting IHs. Elastic deformation and viscoelastic creep also differentiated involuting IHs from those with active endothelial cell proliferation.

We examined the effect of age on biomechanical properties of the control site for the population of infants and toddlers to determine inherent tissue changes over time. Significant age effects were observed as follows. Net elasticity, overall elasticity, biological elasticity, total recovery, and elastic recovery all increased with increasing age. Residual deformation, viscoelasticity, and viscoelastic creep decreased with increasing age.

Conclusions:
Objective measurement of biomechanical properties of cutaneous lesions such as infantile hemangiomas may be a useful strategy to characterize disease progression and response to treatment modalities and to permit standardization across institutions. The measurements can be made easily and quickly in clinical settings with the infant and young child populations.

O33

Internal stress and tension forces of human skin during aging

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Keywords: Aging, 3D network of fibers, elastic modulus, internal stress, strain, skin tension forces, 3D morphology, skin lines, anisotropy

Introduction

The human dermis is structured with a network of collagen and elastic fibers. This fibrous morphology can be represented as a three-dimensional network of fibers with directions perpendicular and parallel to the skin surface. This network of fibers prints on the surface of the stratum corneum a three dimensional morphology of lines which express the mechanical tension of the skin at rest. Several studies have demonstrated changes in the network of lines with age, leading to deepening of certain lines and the disappearance of others. However, quantitative and detailed descriptions of the link between the modifications of skin lines with age and internal stress and tension forces are rarely reported in the literature.

Objectives

The objective of this work is to determine the internal stresses and forces of skin tension during aging. The study focuses on the area of the left forearm of Caucasian women.

Methods

A study on the forearm of three groups of healthy Caucasian women aged of 20-30, 30-50 and 50-60 years old has been performed.

To characterize the internal stresses and the tension forces during aging, we associate a mechanical measurement of elastic modulus and the three-dimensional imaging of the skin morphology during aging. We consider that the skin relief is the signature of tension forces and stresses exerted by the network of elastin and collagen fibers which induce a plane stress field on the skin surface.

The three-dimensional geometry of skin surface is measured through the silicone replicas by a white light confocal microscope. The basic parameters for the calculation of internal stress and tension forces are determined from the lengths of the furrows in both x and y direction and their orientation), the representative volume which includes the total length of furrows and the total amplitude of skin relief. The modulus of elasticity is measured in vivo in the same area was measured the geometry of skin line network. The method uses indentation at low load and simultaneously measures the deflection and the force of indentation. The force of 20 10-3 Newton was used for the measurement of elastic modulus of all subjects.

The coupling of the value of the modulus of elasticity and the geometric parameters allows the determination of the stresses in the x and y direction, the shear stress, the skin tension forces in both directions x and y and the vertical deformation orthogonal to the plane of constraints: ε_z

Results

Significant differences between mechanical parameters are shown with ageing:

The reduced Young's modulus of 19. 87 +/- 2.41 kPa for the youngest group (G1) and 14.52 +/- 1.38 kPa for the group (30-50 years old: G2) and 9.75+/- 1.78 KPa for the group (50-60 years old: G3).

Comparison of the three groups in terms of internal stress (stresses in the x and y direction: σ_x,σ_y), the shear stress: τ_{xy} , and tension forces F_x,F_y, show a significant reduction in the internal stress and the skin tension forces.

Conclusion

An important outcome is the change in vertical deformation perpendicular to the plane of stress: ε_z. This deformation decreases negatively for G1(ε_z=-0.12) and G2 (ε_z=-0.10) which reflects the effect of a stenosis), however this strain becomes positive for the G3 group (ε_z=0.29), showing dilatation of skin tissue for advanced subjects in the age, which may explain the increase in skin relief and wrinkles during aging.

This new approach provides a simple quantitative assessment of the physical properties of the skin, revealing that the skin loses tension during aging and becomes subject to compressive stresses and reached significant expansion with aging.

POSTERS

P01

See abstract in O01 podium session.

P02

A Photonumeric Crow's Feet Grading Scale

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Key Words: Imaging, wrinkling, expert grading

Background: With consumer desire for anti-aging products which reduce the size or appearance of wrinkles being a steady force in the personal care market, methods and instruments are being developed which attempt to accurately measure the depths, lengths and amount of wrinkles on the skins surface. For most consumers, the appearance of a significant reduction in the crow's feet wrinkles would be a successful outcome for an anti-aging product. Many products which panelists and consumers perceive as reducing wrinkles in this region do not show a significant reduction in measured wrinkle size. This may be due to the mode of action of the product (optical rather than actual reduction) as much as to the difficulty of accurately measuring wrinkle size and depth. Because of this, panelist as well as expert grader assessments are still important tools for measuring the success of an anti-aging treatment.

Purpose: The intent of this research is to present a photonumeric crow's feet grading scale which has been used to validate several replica analysis devices and, by using this data, evaluate the factors which affect perception of wrinkling most significantly.

Methods: Standardized imaging was used to capture images of crow's feet which were determined by a grader to represent grades 0-8 on a 9 point scale. Replicas were collected from these same crow's feet which were then used to validate and calibrate several devices, including the CK Visioline VL650. These data were used to assess the significance of specific wrinkle attributes (such as length, depth and quantity) on a graders perception of wrinkling.

Results: The results of this research show a strong correlation between expert grader ratings of skin wrinkling and the “Max Depth” value reported by the Visioline. The "Area Ratio" value provides a similar correlation if filtering is used to measure only the deep furrows. Wrinkle length does not show a significant correlation with expert grading while number of wrinkles correlates inversely with expert grading.

Conclusions: It is apparent from this research that the primary attribute of wrinkling which affects a graders, and presumably consumers, perception of severity is the depth of the largest wrinkles. In fact, with aging, the overall amount of wrinkling by area may decrease (as smaller wrinkles becomes smoothed out) while the depth of the deep furrows increases. The use of an anti-aging product does not often cause a measurable change in wrinkle depth, therefore expert grading is necessary and valuable to determine if a product has the potential to be successful in the marketplace. Photonumeric grading has been shown to be more reproducible and repeatable than just descriptive grading and therefore a photonumeric crow's feet grading scale is a valuable tool in assessing product efficacy.

P03

Comparative efficacy of skin lightening technologies in multiple country populations

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Key words: skin lightening, skin whitening, Chroma Meter, VISIA-CR facial imaging, hyperpigmentation, melasma, solar lentigines, Individual Typology Angle, L* a* b* values

Introduction: Skin hyperpigmentation is of social and cosmetic concern to many individuals because of its prevalent appearance on visible parts of the body, namely the facial area. There are number of skin whitening technologies that are currently approved in many countries in Over the Counter equivalent product categories. It is of interest to compare their efficacy in a clinical setting.

Objectives: The purpose of this study is to compare the efficacy of four skin lightening technologies. We assessed the skin lightening response at multiple time points using instrumental methods, image analysis and clinical grading in two different country populations.

Methods: Two skin lightening clinical studies were conducted simultaneously at two separate centers: Dermapro Ltd, Seoul, Korea and Bejing Sino-German Union Cosmetic Institute Co., Ltd., Beijing, China. There were 198 and 180 female subjects between the ages of 30-65 with hyper-pigmentation, melasma or solar lentigines on the facial skin area recruited for the study in Korea and China, respectively. Upon recruitment, subjects were randomly assigned into one of four treatment groups as follows: 1) 2% Ascorbic Acid 2-Glucoside, 2) 3% Arbutin, 3) 7% Arbutin, 4) 1% Kojic Acid. The efficacy of treatment products was assessed with color reader Konica Minolta CR-400 Chroma Meter by Konica Minolta Inc. (Tokyo, Japan), facial imaging VISIA-CR with Mirror software by Canfield Scientific Inc. (Fairfield, NJ, USA), and clinical grading by a dermatologist at baseline, and after 4, 8, and 12 weeks of consecutive use. Baseline color values were investigated closely for their differences in Korean and Chinese populations separately. A series of t-tests were used to assess the differences in color values between the populations. Product efficacy was assessed using a paired t-test, and differences in product efficacy was analyzed using ANOVA followed by Tukey comparison. Treatment effect was compared between types of hyperpigmented spots, i.e. melasma versus solar lentigines, using a two-tailed t-test. The level of significance α was set to 0.05. The heatmaps displaying Spearman correlation coefficients and associated dendograms were built to visualize the magnitude of correlation between the effect assessed by instrumental methods and clinical grading, and also instrumental methods and image analysis. The data were analyzed using statistical software JMP by SAS Institute Inc. (Cary, NC, USA).

Results: Upon examining the baseline color values derived by chromameter measurements in Korean and Chinese populations, it was observed that L* values of Korean subjects were significantly higher in the case of non-hyperpigmented skin (p-value < 0.0001) and solar lentigines (p-value = 0.0009), but not in the case of melasma. Additionally, Individual Typology Angle (ITA°) that is based on L* and b* colorimetric parameter was significantly higher in Korean women as compared to Chinese in the case of non-hyperpigmented area (p-value <0.0001). However, the difference in ITA° values was not significant in the case of hyperpigmented skin. Korean subjects show a steady increase in L* values at 4, 8 and 12 weeks post treatment with no significant difference between products. The type of pigmentation did not have a significant effect on change in L* value in Korean population. When assessing ITA° value change on non-hyperpigmented skin in Korean population it was observed that 1% Kojic Acid did not show a significant improvement, but the rest of treatments did. Chinese subjects showed mixed responses to skin lightening treatments,

with some treatments showing no significant or consistent change between time points. However, after 12 weeks of treatment, the change in L* value showed significant increase with no significant difference between treatments. Regarding differences in response between melasma and solar lentigines, results did not differ significantly at 8 and 12 weeks. Interestingly, the hyperpigmentation lightening effect observed in Chinese population at 12 weeks was significantly lower compared to Koreans in all treatments with the exception of the 1% Kojic Acid treatment which did not differ significantly between country populations. When assessing the ITA° value change on non-hyperpigmented skin in Chinese population, it was observed that after 12 weeks only the 7% Arbutin treatment showed a significant improvement, while the rest of treatments showed no significant change. This finding is different from the finding in the Korean population, and the 2% Ascorbic Acid 2-Glucoside and 3% Arbutin treatments performed significantly better in lightening non-hyperpigmented skin of Korean women. The change in color values assessed by instrumental methods and image analysis showed a strong positive correlation in the case of L* and b* values, but in the case of a* values there was only moderate linear correlation. Moreover, the changes in response to treatments detected with clinical grading did not correlate with the changes detected by instrumental methods or image analysis.

Conclusions: Analysis of baseline color values showed bigger contrast between hyperpigmented and non-hyperpigmented skin in Korean subjects, and perhaps this difference is the cause of the more pronounced effect in response to treatments products in Korean population compared to Chinese. The analysis of product efficacy showed all four technologies to have a lightening effect on hyperpigmented skin spots. However, in non-hyperpigmented skin only the 7% Arbutin treatment induced a significant effect in both country populations. It was determined that there is no difference in response of melasma and solar lentigines, and therefore subjects with both types of pigmentation can be recruited for future studies. The study found a strong positive correlation between the effects assessed by instrumental grading and image analysis. Image analysis is considered to be the preferred analytical method due to the lack of direct skin contact and, therefore, less interference with the skin color. Clinical grading is still an important measurement as it indicates the effect perceivable by human eye.

P04

Distribution of corneodesmosomes on superficial corneocytes differs between infants and adults: a new look at the stratum corneum maturation

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Keywords : infants’ skin, corneodesmosomes, stratum corneum barrier, scanning electron microscopy

Introduction

Maturation of the epidermal barrier in the infancy and its evolution during the senescence and in diseases have an important impact on the overall skin appearance and function. Among other actors, corneodesmosomes play a critical role in the stratum corneum (SC) cohesion and skin barrier function. Longitudinal studies in human populations are difficult to perform because they often require the use of invasive techniques, incompatible with the ethical requirements.

Objectives

Here, we propose a new ultrastructural approach with immunodetection of corneodesmosin for evaluation of skin surface corneocytes. The method was applied to explore the organization of superficial stratum corneum in infants and children.

Methods

D-squame adhesives were used to collect the most superficial corneocytes from the volar face of forearms in 4 age groups of healthy infants, children and adults (n=5, each): 5-6 weeks-old; 12-18 months-old; 4-5 years-old, and 20-35 years-old adults. The samples were labelled with an anti-corneodesmosin antibody (Abnova) and goat anti-mouse IgG 1nm immunogold (Amersham) amplified with silver enhancement kit (British BioCell). D-squame fragments were then examined in partial vacuum (1 Torr) at 30 kV with a Quanta 250 FEG scanning microscope operating at back-scattered and secondary electron modes. Digital pictures of isolated corneocytes and of non-dissociated cell packages were used for evaluation of the cell size and corneodesmosome distribution. ImageJ free-access software was used for quantitative studies. Mann-Whitney test was used for the statistical analysis.

Results

Surface relief of the samples was clearly appreciable with the back-scatter mode whether the immunogold labelling signal was better visible using the secondary electrons. The labelling specifically localized to the disrupted corneodesmosome structures distributed mainly on the lateral rims of the flattened cells. Percentage of corneocytes presenting additional labelling at the area of the central plateau was significantly lower in the youngest group (1.38 ±0.08) vs. 3 other age-groups (8.90 ±1.78, 8.36 ±0.74, and 7.34 ±0.93, respectively; $P<0.01$). In young babies, corneocytes occurred in thick and irregular packages, strikingly contrasting with the even cell distribution in the older age groups. Projected area of the individual cells progressively increased with age from 646.3 ±52.2 μm^2 at 5-6 weeks to 895.5 ±67.8 μm^2 at the adult age ($P<0.01$).

Conclusions

We could show by an immune-electron microscopy approach a correlation between age and structural SC maturation.
The observed evolution indicates a poorly controlled process of corneocyte desquamation in newborns and a consolidation of the SC and normalisation of the desquamation process already in the infants of 1-2 years.
Our study confirms the relative immaturity of the epidermal barrier up to 1-2 years after birth.
The corneocyte surface can be used as a marker of SC maturation.
This innovative approach and the resulting findings introduce new knowledge on infant and children skin and suggest their specific age-related needs.

P05

Surface isotropy as a marker for epidermal maturation in infancy: development and validation of the electron microscopy isotropy (E.M.I) score

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Key words : skin surface – maturation – isotropy

Introduction

The postnatal period is a time of active functional maturation and cutaneous adaptation to the dry extra-uterine environment. Over the last decade, knowledge on new born skin physiology has evolved.

Objectives

We focused our research on the development and organization of epidermal barrier. The present in vivo study investigated new assessment of the micro-morphological skin surface evolution and maturation on different age groups of young children including new born and resulted in a patented score: E.M.I. (Electron Microscopy Isotropy) score.

Methods

Adhesive tapes were collected on the volar forearm in 36 healthy male and female volunteers in 6 age groups (n= 6; each group) new-borns (1-15 days), 5 weeks, 6 months, 1-2 years, 4-5 years and adults aged 20-35 yrs. In the confirmatory trial, 30 volunteers in the same age groups with n=6 per group were analysed without the new-born group.

The corneocytes attached to the non-invasively removed D-Squames were analyzed subsequently by scanning electron microscopy (SEM) and magnified up to 500x. Based on print-outs of the SEM pictures, a surface score was developed with the following parameters: cell density, cluster formation, adhesion/cell shape and differentiability of single cells. The score is scaled from 0 to a maximum of 12 points into three categories (immature, intermediate, mature). The pictures of the confirmatory study were evaluated in a blinded fashion by two independent dermatologists based on four different areas of each D-Squame.

Results

With the first study we developed a score that allows the non-invasive semi-quantitative analysis of surface isotropy. A first trend of higher score values with increasing age was detectable. In the confirmatory study we were able to show and confirm a clear correlation between age and the E.M.I. score. Two different kinetics of maturation were observed in both studies: a high maturation rate from birth to the age of 2 years, apparently leading to the state of maturity of the skin surface, followed by a clearly slower rate of E.M.I. score evolution from 2 years-old to adults.

Conclusion

The patented E.M.I. score based on non-invasively removed surface squames represents an innovative tool to analyse skin surface micro-topography at different age groups. We could show a correlation between E.M.I. score values and increasing age. Skin maturation is reached around 1-2 years. This score is indicative of being a marker of skin maturation and is related to the organization of the skin micro-anatomy after birth.

P06

Regulation of skin water flow: evaluation of a vegetable extract, from in vitro efficacy to clinical evidence using Raman Spectroscopy

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Key words : hydration, skin barrier, NMF (natural moisturizing factor), Raman spectroscopy, clinical studies

Introduction

Preservation of skin hydration can be achieved by the mean of two parallel actions: enhancement of water binding and distribution and prevention from its evaporation by reinforcement of the barrier function.

Objectives

An active ingredient from Acacia Macrostachya seeds, obtained from a sustainable supply chain, was developed according to an eco-designed process. Its effects on key factors in the maintenance of skin hydration were investigated in vitro and we confirmed its in vivo efficacy by conducting a randomized double-blinded placebo-controlled intra-individual trial.

Methods

In vitro and ex vivo evaluations:
In vitro: Normal human epidermal keratinocytes (NHEK) were incubated for 24, 48 or 72 hours in presence of the vegetable extract at 0.1% or 0.2%. Gene expression levels of PAD1 (Peptidylarginine Deiminase 1), caspase 14, filaggrin, keratin 1, keratin 10 and loricrin were evaluated by real-time RT-PCR. Filaggrin production was measured by cell ELISA. Expression of claudin-1 was evaluated by fluorescent immunostaining. Intracellular transglutaminase enzyme activity was assayed by a colorimetric assay.
Normal human skin explants underwent delipidation by a mix of organic solvents and were then topically treated by a formulation containing 0.6% of the vegetable extract or its placebo. The expression of filaggrin and aquaporin-3 was evaluated by fluorescent immunostaining on cryosections.
In vivo: Twenty three women (aged 18-65 years; mean age: 49 years) with dry skin (corneometer values between 30 and 40 i.u.) were included in the study. According randomization, active formula (0.5% Acacia Macrostachya) was applied on one forearm, whereas the other forearm received the placebo formula and served as a control. Water concentration profile as well as the NMF / pyrrolidone carboxylic acid content was assessed by Raman spectroscopy before and after 29 days of application of products.

Results

The vegetable extract was able to stimulate the pathways of Natural Moisturizing Factor (NMF) synthesis. Indeed, in keratinocytes, it increased the NMF precursor filaggrin both at the gene (+64%, $p<0.01$) and protein (+191%, $p<0.01$) level, as well as two enzymes involved in the degradation of filaggrin to form NMF: PAD1 (+194%, $p<0.001$) and caspase 14 (+82%, $p<0.001$) at the gene level. The effect on filaggrin was confirmed on delipidated skin explants, where the vegetable extract was able to restore its expression as well as that of aquaporin-3. These results show the potential of the extract to enhance water trapping and distribution into the epidermis.
Furthermore, the vegetable extract may limit water loss by a reinforcement of the barriers at the level of the stratum corneum and tight junctions: indeed, it was able to stimulate the expression of claudin-1 (+61%, $p<0.05$), keratin 1 (x4, $p<0.001$), keratin 10 (x3, $p<0.001$) and loricrin (x3, $p<0.01$), as well as transglutaminase enzyme activity (+39%, $p<0.05$).
Results of the clinical study showed that the vegetable extract induced a significant increase of NMF content (+104%), water content (+129%) and SC thickness (+123%) compared to the placebo ($p<0.05$) assessed by Raman Spectroscopy in the horny layer of the skin on volar forearms.

Conclusion

Results of the present studies underlined the high potential of the acacia extract to stimulate NMF and aquaporins components to revitalize skin water flow as well as to control water loss by a reinforcement of epidermal barrier. Thus this active ingredient offers to the skin an active cellular hydration.

P07

What is different in skin physiology in neonates and young children of different age groups compared to adults? A randomized in vivo study

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Keywords: Skin physiology, Neonates, Raman spectroscopy

Introduction

The skin of neonates and children has anatomical and physiological differences compared to adults e.g. in water content, perspiration, light sensibility, percutaneous permeability, susceptibility to infections and irritants as well as to topical treatments.

Objectives

The aim of the present study was to investigate non-invasively physiologic skin parameters (transepidermal water loss (TEWL), stratum corneum (SC) hydration, surface pH) and the biochemical epidermal composition (water profile and bulk NMF) to characterize neonatal skin in comparison to different children age groups and adults.

Methods

The study was performed in healthy male and female volunteers (n=108) of 6 age groups (n= 18 each group: newborns (1-15 days), five-week, six-month, 1-2 yrs., 4-5 yrs and adults aged 20-35 yrs.). Biophysical parameters (TEWL, capacitance and surface pH) were measured on the volar forearms non-invasively. Water- and bulk NMF-profiles where assessed with in vivo Raman spectroscopy (RS).

Results

The lowest SC hydration was noted in newborns (1 to 15 days) compared to all other age groups representing a dry SC in newborns. The mean skin surface pH-value was highest in newborns. A decrease of approx. one pH unit was observed over the first 5 weeks, representing a quick stabilization of pH within the first weeks of life. In the present study mean TEWL values under basal conditions were below 10 g/m²/h reflecting a normal and competent barrier function in all six age groups.

An increase in SC hydration within the first weeks of life was detected in the water profile assessed with RS measurement. The newborns showed a slower increase in water content in correlation to increasing skin depth compared to the other age groups. Newborns showed greater bulk NMF concentrations - especially in a depth of 5 – 15 µm. It seems that the lack of water in mid and deeper layers is compensated by a high NMF level in the skin surface induced by filaggrin breakdown after birth.

Conclusion: Neonatal and infant skin is competent under basal conditions except SC water content and NMF components regulating the SC hydration level. Newborns are adapting to the dry environment by compensating the lack of water with increased NMF.

P08

Vascular inflammation and innate immunity modulation: ways for skin blemishes correction

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Key words: facial redness, angiogenesis, inflammation, clinical studies, images analysis, cross polarized images

Introduction

Numerous factors such as modern-life associated stress, chemical or mechanical aggressions, UV radiations can lead to the development of cutaneous blemishes (redness, pimples, spots…). At the cellular and molecular level these imperfections are first initiated by an inflammatory reaction that can involve aspecific, vascular or neurogenic mediators.

Objectives

We have developed schizandra hydrolysate (SH), an active ingredient from Schizandra sphenantera cake, according to a biotechnological process, in compliance with our sustainable policy. The patented ingredient is secured and optimized, containing a high peptides concentration at specific molecular weights distribution.

Schizandra hydrolysate has been evaluated on in vitro models reproducing the specific features of rosacea pathogenesis and and we confirmed its in vivo efficacy by conducting a randomized double-blinded placebo-controlled trial.

Methods

Normal human epidermal keratinocytes (NHEK) were stimulated by calcitriol (hormonally active form of vitamin D) in presence or not of schizandra hydrolysate. Gene expression of kallikrein-5 (KLK5) and the cathelicidin LL37 were evaluated by quantitative real-time RT-PCR.

Inflammation was induced on NHEK by PMA treatment, the effect of schizandra hydrolysate on the release of VEGF, IL1beta, IL6 and IL8 was followed by ELISA.

NHEK were treated by schizandra hydrolysate, gene expression of VEGF, FGF2 and thrombospondin-1 were measured by quantitative real-time RT-PCR.

Normal human dermal microvascular endothelial cells (HMVEC) were treated by VEGF, in presence or not of schizandra hydrolysate. Cell viability was evaluated by determination of intracellular phosphatase activity using a spectrophotometric assay.

HMVEC were incubated in presence of schizandra hydrolysate or insulin; the quantity of endothelin-1 was measured by ELISA.

60 women aged from 18 to 50, with sensitive skin (stingers), phototypes I to III and installed redness (Erythemato Telangiectasic Rosacea ETR) were enrolled in a double-blind, placebo-controlled study. 31 volunteers applied the active cream (0.5% of schizandra hydrolysate) and 29 a placebo, twice daily on the whole face for 56 days. The study was performed from february to april. Efficacy on redness was evaluated by cross polarized digital images analysis and self-assessment questionnaires at D28 and D56.

Results

In normal human epidermal keratinocytes (NHEK), SH significantly inhibited the pro-angiogenic factor VEGF at the protein level (measured by ELISA) in response to PMA (-72%, $p<0.001$) and at the gene level (-89%, $p<0.001$) (measured

by real-time RT-PCR). Moreover, SH reduced FGF2 (-93%, $p<0.001$) and stimulated thrombospondin-1 (+118%, $p<0.01$) gene expressions.

SH significantly modulated VEGF-induced proliferation of human dermal microvascular endothelial cells (-52%, $p<0.05$) as assessed by intracellular phosphatase activity.

SH significantly reduced KLK5 (-54%, $p<0.01$) and LL37 (-58%, $p<0.01$) gene expressions in calcitriol-treated NHEK, demonstrating its ability to normalize innate immunity.

SH significantly reduces facial redness after 56 days especially on blood vessels area criteria (-44.6%, $p<0.05$). We also observed a significant reduction of the contrast between redness and healthy skin (-41.2%, $p<0.05$). Furthermore, women confirmed the significant efficacy of the active cream on facial redness.

Conclusions

SH regulates the main pathways of vascular inflammation via a modulation of angiogenesis and vasodilation and, moreover, shows a normalizing effect of innate immunity. These in vitro activities are translated in the clinical improvement of facial redness and contrast resulting in a corrective and unifying effect on complexion.

P09

The skin analysis system based on image pattern for both simple and multi-meaning evaluation; Hydration pattern, and skin texture pattern

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Key words: image pattern, hydration, texture, one-step, fingerprint, multi-meaning evaluation

Introduction:

The skin plays a role as the barrier to protect our body from external materials and it is also related with cosmetics that most females use. So, to understand the skin conditions is very important physiologically. Although there are many methods to measure and to analyze skin properties currently, they are not completely satisfactory in a few aspects. Especially, an individual user is limited to control most of the diagnostic equipment in technical view.

Objectives:

The commercially available systems for skin diagnosis are difficult for users to understand the results and to carry out comprehensive evaluation or analysis with each skin condition because they are oriented to numerical contents. To solve these drawbacks, we developed the diagnosis system to carry out both simple and multi-meaning evaluation of each skin phenotype. It is based on hydration and texture pattern using fingerprint scanner. It is possible to scan images easily and to analyze overall image pattern by classifying them to a few types in macroscopic point.

Methods:

After touching fingerprint scanner (UPEK TouchChip TCRU1C Capacitive Fingerprint Scanner) to various parts of face, we selected appropriate parts for scan of image pattern and their image patterns were analyzed in the program using MATLAB. For analysis of hydration pattern, MGL (Mean Gray Level), MTH20 (Mean Threshold Histogram 20%) and Error rate are utilized as the parameters. For analysis of texture pattern, the number of starformation and the size of cell area are calculated after transformation to watershed image. We classified patterns to a few types by specific criteria with measured parameters, and then researched meanings of each image pattern in morphological and physiological points.

Results:

First of all, we have verified the significance of parameters proposed in hydration and texture pattern by analyzing the correlation of them and common parameters(water content measured by Corneometer®, transepidermal water loss(TEWL) measured by Tewameter®, etc.).

After that, we classified hydration pattern to six types and displayed it to 3D color map for user's understanding. The six types consist of three MTH20 levels and two Error rate levels within each MTH20 one. Three MTH20 levels are 'insufficient hydration', 'medium hydration' and 'sufficient hydration'. Two Error rate levels, variation of MTH20 and MGL, are 'homogeneous hydration' and 'heterogeneous hydration'. The description of each type was also included.

Texture pattern was classified to three types after dividing the values of starformation and cell area to three levels (Low, immediate and high) and shown to 3D color map with watershed image. Three types are 'aging-beginning', 'aging-progress' and 'aging-severity'.

Conclusions:

We have overcome the existing drawbacks from skin analysis system based on image pattern. It provides a lot of information to us about skin in macroscopic point instead of local point and carries out multi-meaning evaluation. Also, the process is executed by one-step from scan to result with commonly utilized fingerprint scanner so users can utilize

the system simply and easily. This differentiated technology by analysis of image pattern and the convenience by one-step process are main advantages in this research. We believe that this system for diagnosis contributes to development in both dermatology and cosmetic domains for the future.

P10

Applications of reflectance confocal microscopy in skin penetration efficacy testing and ingredient screening

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Keywords: Reflectance Confocal Microscopy, Fluorescence, Skin Penetration, in vivo

Introduction: Skin penetration is a complex process that largely relies on the properties of penetrating compounds and the structure and chemistry of skin. Conventional Franz cell method is not suitable for in vivo clinical studies, and tape stripping is invasive, labor-intensive and often inaccurate. Reflectance confocal microscopy (RCM) is a non-invasive imaging tool that enables in vivo imaging of skin structures at a resolution comparable to conventional histology. The recent development of fluorescent imaging capability of RCM provides better contrast than reflectance imaging and more importantly, it can now potentially be used to track skin penetration both in time and space.

Objectives: Our goal was to compare different delivery systems for skin penetration and develop visual and objective methods using fluorescence RCM.

Methods: Three different delivery systems were investigated, including lotion, a wet cloth mask and a skin adhering mask. Fluorescein was formulated into these delivery systems and used as the tracking molecule for the study. Confocal images of fluorescein penetrating across skin depth at two different time points, 30 minutes and 4 hours, were taken using fluorescence RCM (VivaScope 1500 multi, Caliber I.D., USA). We developed new software programs and used them to visualize and measure fluorescein quantitatively in the skin. Penetration coverage and penetration depth were calculated and compared among the three delivery systems.

Results: In this study, both cloth and adhering masks provided significantly better coverage (>7 times) and penetration depth (1.6-1.9 times) than lotion at both the time points. The adhering mask delivered fluorescein significantly deeper (8%-65% more) than the cloth mask after 4 hours. These differences in the penetration coverage and depth demonstrated the difference in the capabilities of the three delivery systems. We also developed new methods for efficacy testing and ingredient screening, which will be also discussed.

Conclusions: We developed visual and quantitative methods to investigate skin penetration using the fluorescence RCM imaging. This method has been successfully applied in testing three skin delivery systems (lotion and two masks). It can also be potentially used for testing the penetration of other ingredients with the assistance of fluorescence tagging technique. Overall, this new in vivo fluorescence RCM method can provide a convenient yet powerful tool for efficacy testing and ingredient screening.

P11

Improved quantification of skin erythema pattern by color analysis of highly standardized photographic images

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Key Words: Erythema, Image Analysis

Introduction

Visual scoring is the time–honored approach for quantification of erythema. With appropriate training visual scoring can be done efficiently, however with only moderate precision and considerable inter-grader variability. Measurements with chromameters are device-based alternatives with greater precision and objectivity. They have, however, their own limitations. First, they are not truly operator-independent. Second, the measurement area is limited to approx. 1 cm². Third, complex pattern of erythema as present in most diseases can not be quantified satisfactorily with chromameters. Usually chromameters integrate over the entire area measured and the intense redness of patchy areas or teleangiectasia are averaged with skin parts without any erythema. Erythema evaluation by quantitative image analysis on highly standardized photographs can overcome these limitations.

Objectives

For advanced color measurements on images the photographic device must provide correct and highly reproducible illumination in terms of color temperature and light intensity. Further all geometric parameters as distance to skin, magnification and angle of illumination must be kept constant.

Methods

In this paper we compare measurements on images obtained with a handheld professional camera system with a distance holder and flash illumination (Canon EOS 5D Mark II with Elinchrom RQ Ringflash ECO) to color measurements with a chromameter (Minolta Chromameter CR400) and visual scoring. Erythema spots of 1 cm² of different intensity were induced on volar forearm skin of six subjects with a solar simulator. Erythema was measured in the L*a*b*- color system with the chromameter and in parallel by quantitative image analysis in photographs.
In a second step facial skin of Rosacea Type I patients displaying teleangiectasia was evaluated by visual scoring, chromametric measurements and image analysis. After that an unobtrusive camouflage product was applied and the assessments were repeated.

Results

The erythema data obtained from the photographs on 1 cm² erythemal spots induced by UV-light showed a good correlation ($r > 0.9$) with visual scoring as well as with chromameter measurements. These results showed that the erythema quantification from photographs had a satisfying precision.

The measurements of camouflage effects on teleangiectatic areas revealed the advantage of the photographic method. The camouflage efficacy derived from the chromameter measurements were not well in line with the visual clinical observation. In the color assessment from the photos not only the average redness but also the variation of red blood vessels and the unaffected surrounding skin were taken into account and the blood vessels were measured separately

from the surrounding skin. As a result the measurements from photographs matched much better with the clinical observations.

Conclusions

In summary, erythema quantification from photographs showed a good correlation with chromametry when the area of interest showed homogenous erythema. In areas with uneven color distribution the color quantification of photographs had the clear advantage because erythema intensity, could not only be over averaged over the whole area but also quantified selectively and hence with greater sensitivity in areas/structures of interest, e.g. teleangiectasias.

P12

SPHINGANINE – The hair cycle balancer

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Key words: prevention of hair loss, Sphinganine, 5-α-reductase, TrichoScan®

Introduction

Hair growth occurs via a well-defined repeated cycle consisting of growth (anagen), regression (catagen), resting (telogen), and exogen phases. Within this repeated growth cycle the human hair follicle is able to regenerate a new hair shaft during each cycle. In general more than 80% of the hair in young and healthy individuals is actively growing (anagen phase). Aging and other circumstances such as androgenic alopecia result in hair follicle miniaturization, which shortens the anagen phase, resulting in hair loss and the formation of fine and lifeless hair.

Sphinganine-based ceramides represent the most abundant ceramide class present in human hair. Based on this, Sphinganine seems to be a promising active ingredient for hair- and scalp-quality promoting applications.

Sphinganine is produced from renewable raw materials such as sugar in a sustainable biotechnology process. The fermentative production process ensures that Sphinganine features the same stereochemical configuration as found in nature and in human skin. The skin-identical stereochemistry of Sphinganine is of key importance for its biological functions.

Several in vitro and in vivo studies were conducted to analyze the beneficial effects of Sphinganine on prevention of hair loss by providing general scalp health and extension of the anagen phase. The inhibitory effect of Sphinganine on the 5-α-reductase, the key enzyme catalyzing irreversible reduction of testosterone to dihydrotestosterone, indicates a positive influence Sphinganine on prevention of hair loss. Among others a TrichoScan® based study including 96 test subjects shows very clearly the positive effect of Sphinganine in terms of prolonging the anagen phase and providing general scalp health.

Methodology

The potential of Sphinganine to inhibit 5-α-reductase type I, the key enzyme catalyzing irreversible reduction of testosterone to dihydrotestosterone, was tested in a cell-free assay using cell homogenates isolated from stably transfected HEK293 cells, yielding an IC50 of 6.6 µM for Sphinganine.

The TrichoScan® method was employed to objectively determine state of the hair life cycle by determining the anagen and telogen rate. Visible and otherwise detectable effects were assessed by expert rating and photographic documentation.

An ethanolic hair tonic containing 0.1 – 0.5% Sphinganine was provided, and volunteers evenly applied this to their scalps (dry hair) and hairlines in the morning and evening, aided by some gentle massage. Measurements were conducted before the first application and after 8 and 16 weeks of product application. Data were considered from a total of 96 test subjects.

Results and Conclusion

The enzyme 5 α-reductase directly affects hair loss in both male and female. Thus, to determine whether Sphinganine has an inhibitory potential towards 5-α-reductase type I, IC50 values were determined. Our results indicate that

Sphinganine is a suitable ingredient to inhibit 5 α-reductase and thus prevents conversion of testosterone to dihydrotestosterone. This could positively influence the hair growth cycle by preventing transition into catagen phase and reversing follicle miniaturization.

The present clinical study demonstrates the in vivo efficacy of Sphinganine in reducing non-illness-related hair loss in men. In the context of the clinical evaluation it was found that Sphinganine furthermore improves hair quality, and indications for the improvement of scalp health were also obtained. Several in vitro studies provide data suggesting the mode of action for these effects. Overall, Sphinganine is a naturally occurring, skin-identical molecule particularly targeting male pattern hair loss by balancing the hair cycle, strengthening the hair follicle, and improving scalp health.

P13

In vivo Imaging of superficial suction blister wounds by confocal reflectance microscopy

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Key words: Suction blister, Epidermal wound healing, Confocal reflectance microscopy

Introduction

Suction blister wounds have been used as a superficial human wound healing model for decades (Levy 1995). By use of a vacuum pump a skin blister of defined diameter is raised. By removal of the blister roof a strictly epidermal lesion is produced that heals in a few weeks without visible scar formation. Confocal reflectance microscopy was already used by Sugata et al (Sugata 2008) to study suction blister wound healing. They investigated the wound healing from 2 to 8 weeks after blister induction and evaluated images of 500 x 500 µm. Dermal papillae were lost in a fresh suction blister wound. A reappearance of dermal papillae was observed over a period of more than 6 weeks.

Objective

Based on the reported findings, the aim of our study was to increase the knowledge of suction blister wound healing kinetics by use of new characteristic confocal reflectance microscopy parameters. We assumed that further aspects of suction blister wound healing could be assessed in case larger wound areas would be scanned in cell layers close to the wound surface.

The progress of wound closure in terms of migration of the border, with reconstituted epidermis from the edge of the blister to the center, should become visible by observing the time dependant appearance of newly formed stratum granulosum cells.

Further, suction blister wounds show a characteristic contraction during healing. This contraction is released at a later stage, when complete closure of the wound is reached. The typical star shaped tension dependant furrows that appear on the wound surface could be quantified to study the kinetics of wound contraction and release.

Methods

For our investigation suction blister wounds (6 mm in diameter) from ten volunteers were made and investigated with the VivaScope 1500 (Lucid, Rochester NY, USA). The blisters were covered with a semiocclusive dressing for protection until day 8. After the first assessment the wounds remained uncovered. Vivascope images were taken on day 8 and day 15 after suction blister wounding. The depth was chosen at the level of the stratum granulosum. A mosaic of 16 x 16 images (each image of 500 x 500 µm) was taken to map the total suction blister. The complete image set (8 x 8 mm) had a resolution of 256 MPix.

Results

On day 8 the wounds were not anymore weeping. In the center a larger area with granulation tissue was visible. A dark appearing rim around the clot was visible with blurred cell shape under magnification, indicating that in this rim zone the formation of normal epidermis was not completed. Outside of the rim zone the magnified images show normal stratum granulosum cell pattern.

The overview images of the complete suction blister on day 8 show clearly visible tension dependent furrows indicating a strong contraction of the wound on this day. The furrows are star shaped and lead from the central granulation tissue zone to the borders of the blister. On day 15 no visible tension dependent furrows remained and the zone with granulation tissue in the center had almost ceased.

Conclusions

Due to the well visible difference in cell pattern the rim zone, were normal epidermis has not reappeared, can be clearly discriminated from the area with reconstituted epidermis. By image analysis the areas of both tissues could be measured over the time of healing. We propose to use this assessment as a new parameter of reconstitution of epidermis during suction blister healing.

Due to the star shaped orientation of the tension dependent furrows the onset and release of wound contraction should be detectable with a higher precision than by a simple measurement via the change of area of the complete lesion.

Further investigations with daily measurements of the proposed parameters and under different wound treatments will be needed to explore the value of the new proposed parameters.

P14

A Novel Cosmetic Formulation for Photo-Rejuvenation

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Objective; to develop a cosmetic formulation that in itself is a therapeutic agent due to its anti-inflammatory and anti-aging properties. Emu oil has excellent skin penetrating features (due to fluidization of the intercellular lipids in the stratum corneum), is a superb emulsifier, has low potential for irritation, and is noncomedogenic. Furthermore emu oil also has anti-inflammatory properties (due to TNF-alpha inhibition) and induces dermal collagen production. Cetirizine also has numerous anti-inflammatory properties.

Methods; This is a continuation of a double blind split face six month study comparing commercially available Tretinoin cream vs. Tretinoin at the same concentration in emu oil base with Cetirizine. In this unpublished ongoing single blinded study volunteers compared a popular commercially available cosmetic product with Nirlana cosmetic line.

Results;
1. Tretinoin/Cetirizine in emu oil base in comparison to Tretinoin cream, based on photographic, patient and physician assessment, was more effective in reducing photo-aging and inducing photo-rejuvenation.
2. Tretinoin/Cetirizine in emu oil base PREVENTED retinoid induced dermatitis/irritation and improved clinical compliance.
3. Based on volunteers self assessment questionnaire Nirlana cosmetic line was more effective than other cosmetic product that are widely available in inducing photo-rejuvenation.

Conclusion; New patented Cetirizine/Emu oil formulation in addition to effectiveness in management and treatment of Atopic dermatitis, Psoriasis, and Acne may also be beneficial in reversing photo-aging and inducing photo-rejuvenation. Based on phenomenal commercial success, in the United States, of commercial products containing Emu oil (Blue Emu and Australian Dream) Nirlana cosmetic photo-rejuvenation line could also potentially be commercially very successful.

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P15

Does topically applied ceramides permeate into stratum corneum and constitute skin barriers?

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Key words: ceramide, IR imaging, IR spectroscopy, skin penetration, skin permeation, human skin, ex vivo

Introduction The proper composition and arrangement of intercellular stratum corneum (SC) lipids are essential to skin barrier function. Ceramides, one of the three SC lipid species, have been formulated into hundreds of skin care products to repair and strengthen skin barriers through topical application.

Objectives To image the permeation and distribution of topically applied ceramides in ex vivo human skin.

Methods Ceramide NS and Ceramide NP with fully deuterated acid chains were topically applied to human abdomen skin explants from an oleic acid suspension at 34□C for 24 and 48 hours. The skin samples were then fast frozen and microtomed to thin sections. The concentration distribution of ceramides in skin was imaged with infrared (IR) microspectroscopy and quantified by CD2 stretching band intensity.

Results Ceramides NS and NP are both distributed sporadically and heterogeneously within SC. They are found to concentrate in glyph regions. The distribution of both ceramides in SC appears to be independent of incubation time.

Conclusions Topically applied ceramides do not permeate or distribute uniformly into human SC and may provide few benefits to enhance skin barrier function by partitioning into SC lipid matrix.

P16

Quantitative analysis of engineered skin regeneration using 3D optical coherence tomography

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Key Words: 3D Optical Coherence Tomography, Engineered skin, Laser therapy, Quantification of skin regeneration

Introduction

As laser technology is advanced, laser therapy becomes a common method for treating various dermatological troubles [1]. The laser treatment offers the effective care of acne and wrinkle in the skin, and it has been extensively used in medical and cosmetic fields. Current laser treatment often requires the procedure to observe laser irradiated skin dynamically and quantitatively [2, 3]. It is because frequent and quantitative observation of skin prevents side effect such as hyperpigmentation, redness and burning. However, there exists no optimal method to characterize the variation of skin before and after laser therapy.

Objectives

In this study, we utilized 3D optical coherence tomography (OCT) to observe light-tissue interaction and tissue regeneration after laser irradiation. OCT is cross-sectional imaging tool which visualizes high-resolution tissue structure, non-invasively [4]. Thus, it is very suitable to monitor skin generation at the same site over time [2, 3]. Our interest is to understand laser tissue interaction and to evaluate the healing process of laser irradiated tissue.

Methods

In order to accomplish this goal, we developed engineered skin model which is close to human skin in terms of morphology and basic function. Engineered skin was irradiated by fractional CO2 laser, which was then imaged by high speed OCT system and analyzed by automatic segmentation software. Irradiation dose of laser was varied to engineered skin and corresponding tissue rejuvenation was observed every six hours for few days. Each sample was fixed by using formalin solution per 6hours after laser irradiation to compare with OCT image.

Results

Figure 1 shows a series of reconstructed skins recovering process to laser irradiated reconstructed skin over 24hours. It makes possible to evaluate the recovery process of samples with different methods. 3D rendering OCT images show three dimensional structure of reconstructed skin including surface area. Another method to evaluate the recovery process is to use 2D OCT images and H&E stained histology. In cross-sectional 2D OCT images, it shows similar appearance to H&E staining of engineered skin. It means that OCT can replace the H&E staining to observe engineered skin, because H&E stained histology have a problem to be destroyed collagen structure in case of slicing the sample. As time goes by, the irradiated region of the reconstructed skin shows similar recovery aspect in H&E stained histology and cross-sectional 2D OCT image. The irradiated holes are filled with collagen in the order of epidermis and dermis within 24 hours.

And then, we demonstrated quantitatively a series of recovery process over time using automatic segmentation, and demonstrates the effect of different laser powers on penetrated hole depth and hole volume in same irradiated position of same sample. As a result, we confirmed the stronger laser power has the higher value of initial volume and the penetrated hole depth. Also, the hole volume and depth make decreasing patterns in proportion to decreasing laser power over time in accordance with quantitative analysis. In this study, we observed interesting outcome which the skin

thickness is another variable to influence skin regeneration. According to different thickness of epidermis, recovery degree of penetrated hole depth and volume is different in same laser power.

Conclusions

We visualized the laser irradiated area of engineered skin, characterized the process of tissue regeneration and compared to conventional histological evaluation. Our results shows that laser irradiated engineered skins were mostly recovered within two days, but it was varied by the laser doses and area. Through this experiment, it is found that 3D OCT could be promising tool to be used in laser therapeutic procedure to monitor and quantify skin which cannot be achievable to conventional methods.

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P17

A clinical tool to identify subjects with sensitive skin

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INTRODUCTION: Sensitive skin is highly prevalent across industrialized countries and is mainly described in terms of neurosensory perceptions. Despite extensive research into the sensitive skin phenomenon, answers on definition, clinical profile and pathomechanisms remain elusive. A perception-based tool for identification of subjects reporting sensitive skin could build a ground for unraveling symptoms and mechanisms of sensitive skin. The objective of this study was to develop a multidimensional questionnaire with a multifactorial data analysis tool with cut-off points for identifying subjects with self-perceived sensitive skin and non-sensitive skin.

METHODS: A digital survey was distributed among a Dutch cohort (n=1168) to investigate eliciting factors and the clinical profile of sensitive skin. The questionnaire included self-reported skin sensitivity, demographic characteristics, skin type, skin diseases and comorbidities, seasonal dependency, and habits regarding cosmetic use and bathing. Discomfort scores on a visual analogue scale (0-100), durations and localizations of various perceptions (stinging, burning, itching, tightness) and objective signs (redness, dryness, papules) following possible endogenous and exogenous triggers of chemical, mechanical and environmental nature were enquired. The results were analyzed using statistical tools based on multifactorial analysis.

RESULTS: 238 complete responses were returned. Thirty-seven percent of subjects reported to have sensitive skin, of which 24.4% reported a very sensitive skin. More females ($p<0.001$) and more individuals with skintype II compared to skintype III ($p=0.058$) reported sensitive skin. The cheeks are the most sensitive body site in sensitive skin subjects. Subjects with sensitive skin more often reported asthma compared to the non sensitive group ($p=.024$) and report significantly stronger VAS scores on all symptoms in response to the stimuli: toiletries, shaving, emotions, cold and heat compared to non-sensitive subjects. A concomitant skin disease contributed to similar scores as having sensitive skin. 88% of subjects with sensitive skin reacted to multiple (≥3) stimuli (non-sensitive skin: 53.3%). Discomfort in general, and erythema are most strongly perceived. Together with dry skin and itch, these symptoms are discriminative for sensitive skin ($p<0.001$). Stinging and burning are no discriminative symptoms. We identified a set of four symptoms occurring following six different stimuli which strongly correlate with self-perceived sensitive skin and we defined cut-off points for sensitive skin and for non-sensitive skin.

CONCLUSIONS: In line with the prevalence known in industrialized countries, the prevalence of sensitive skin in the Dutch population is approximately 37% and is high. The pathomechanism of SS in individuals is elicited by multiple triggers of different origins: mechanical, chemical and environmental, where multiple pathways could trigger the sensitive skin pathomechanism. We identified specific symptoms and provoking factors and developed a scoring scale, which can be used to identify sensitive subjects to further fuel sensitive skin research. As subjects with concomitant skin diseases were found to react as strong as sensitive subjects, we recommend that these subjects should be studied as a separate population in investigation of sensitive skin. The developed selection tool requires validation by application in clinical studies.

P18

Photoacoustic molecular imaging of ferritin as reporter gene in SK-MEL-24

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Key words : phoatoacoustic, ferritin, human melanoma

1. Introduction

Reporter genes may serve as endogenous contrast agents in the field of photoacoustic (PA) molecular imaging (PMI), enabling greater characterization of detailed cellular processes and disease progression. Objective : To demonstrate the feasibility of using ferritin as a reporter gene, human melanoma SK-24 (SK-MEL-24) cells were co-transfected with plasmid expressing human heavy chain ferritin (H-FT) and plasmid expressing enhanced green fluorescent protein (pEGFP-C1) using lipofectamine™ 2000. Nontransfected SK-MEL-24 cells served as a negative control.

2. Methods

Fluorescent imaging of GFP confirmed transfection and transgene expression in co-transfected cells. To detect iron accumulation due to ferritin overexpression in SK-MEL-24 cells, a focused high-frequency ultrasonic transducer (60 MHz, f/1.5), synchronized to a pulsed laser (fluence < 5 mJ/cm(2)) was used to scan the PA signal at a wide range NIR wavelengths (850-950 nm).

3. Results

PA signal intensity from H-FT transfected SK-MEL-24 cells was about 5-9 dB higher than nontransfected SK-MEL-24 cells at 850-950 nm. Immunofluorescence and RT-PCR analysis both indicate high levels of ferritin expression in H-FT transfected SK-MEL24 cells, with little ferritin expression in nontransfected SK-MEL-24 cells.

4. Conclusion

In this study, the feasibility of using ferritin as a reporter gene for PMI has been demonstrated in vitro. The use of ferritin as a reporter gene represents a novel concept for PMI using an endogenous contrast agent and may provide various opportunities for molecular imaging and biophysics research.

P19

Quantitative Analysis of Multiple Photoaging Features using Image Analysis of Digital Photographs

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Key words: image analysis, photoaging, wrinkles, pores, pigmentation, skin tone evenness

Introduction:

Facial photoaging conditions are typically assessed through clinical grading by expert graders with support from instrumental measurements on the biophysical properties of the skin. Digital photographs are often taken as a record or for demonstration purpose. We believe that digital photographs reliably capture the global face conditions and can be utilized for analysis of photoaging on the global face. This would provide an objective and quantitative assessments for facial photoaging.

Objectives:

We sought to develop a set image analysis tools to objectively and quantitatively assess facial photoaging conditions using digital photography. The various facial photoaging features include wrinkles, pores, pigmentation, and skin tone evenness.

Methods:

Digital photographs were taken under specially designed lighting conditions, raking light, standard visible light, or cross-polarized light. The resulting high resolution digital images were analyzed using Image Pro software. Automated methods were developed to align post baseline images with baseline images and assess specific features, such as wrinkles, pores, pigmentation, and skin tone evenness, within the same specified areas. Unique combinations of imaging filters were applied to identify each specific feature. For example, special algorithm was used so that glossy effect of lip product does not interfere with lip wrinkle analysis. Although pores and pigmentation can be analyzed using the same photo the features do not cross identify each other. And a new concept, skin tone evenness index, was developed according to the assessment considerations of clinical evaluation.

Each analysis method was first developed and evaluated visually. Subsequently, the analysis results were compared to clinical grading scores. Further, these methods were applied to various clinical trials.

Conclusions:

The set of image analysis tools we developed are able to accurately capture desired photoaging features on the face and provide quantitative and objective assessments of facial photoaging conditions. Most parameters demonstrate good correlations with clinical grading scores, confirming the validity of the methods. The advantage of our image analysis methods is that they were developed in close relationship with expert clinical evaluation to take into account the various considerations and thought process during clinical assessment and they have been validated through clinical studies. For skin tone evenness analysis it has the advantage over bioinstrument measurement as larger area on the face can be evaluated instead of sampling a specific spot.

These analysis methods have been applied to multiple clinical trials and they are able to pick up the changes before and after product usage with the changes trending similarly to results from clinical grading. In the case of wrinkle analysis, it has been used in split-face design clinical trials and able to distinguish control vs. test materials.

P20

Infantile hemangiomas: progression and dynamic infrared thermography

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Key Words:
skin, infant, infantile hemangioma, ontogeny, objective measurement, infrared thermography, dynamic infrared thermography, high resolution digital imaging, propranolol

Introduction:

Infantile hemangiomas (IHs) are benign rapidly proliferating vascular neoplasms occurring 12% of births. They exhibit increased angiogenesis and/or vasculogenesis, disorganized structure, increased perfusion and resultant higher temperatures versus uninvolved tissue. They and may be superficial, deep or mixed based on the dermal involvement. IHs have high blood flow until 6-10 months, stabilize and then slowly involute with reduced blood flow for 7-10 years. Temperature distribution at the skin surface depends upon blood perfusion, metabolism, thermal conductivity, drug effects, sympathetic nervous system activity, and environmental conditions. Surface temperature is by tumor size and depth, i.e., inversely with distance of the vasculature from the surface. As a result, measurement of surface temperature distribution may be useful in determining the physiological status, disease progression and treatment response of IHs.

Objective:

The objective was to determine the disease status as a function of time, i.e., age, by measuring the dynamic thermal responses to a cold stress among subjects with mixed or superficial infantile hemangiomas. We compared the thermal behavior as a function of IH depth of involvement.

Methods:

A prospective within control observational study was conducted among fifty-seven patients with mixed (n = 41) or superficial (n = 19) who were less than five years old. They were either treated or observed (untreated) as determined by the physicians. The Institutional Review Board approved the protocol and parents/guardians provided written informed consent.

High-resolution digital images were taken to quantify color. Standardized IR images of IHs and uninvolved control sites were taken with a FLIR T400 camera (emissivity 0.98) perpendicular to the skin at 60 cm. Static thermal images were acquired first and later co-registered with the color images for clinical evaluation of regions of thermal activity. A cold stress (18 ± 0.2°C) was applied for 30 sec. The rewarming behavior was recorded at 7 frames/sec. Effects of the uninvolved control tissues were removed by using a threshold of the highest 10% of the temperature immediately after cooling. Distributions of thermal intensity and area were during rewarming were analyzed with Matlab®. Outcomes were temperature change with cooling, area under the curve during rewarming (AUCrw), and time to maximum temperature The impact of time was assessed by grouping the individual data by age (months) at evaluation for 1-3, 4-6, 7-9, 10-18, 19-36 and > 36. The thermal responses were analyzed with univariate general linear models procedures with treatment as a covariate with a $p < 0.05$ significance level.

Results:

The temperature difference between IH and uninvolved skin was after cooling 3.6 ± 0.2°C compared to the difference at room temperature 1.0 ± 0.1°C $P < 0.0001$). For mixed IHs, there were reductions in the temperature lowering with

cooling and the area under the curve during rewarming for mixed IHs (P = 0.000 and P = 0.000, respectively) as a function of time (age). These decreases were significant by the 10-18 month period. The time to maximum temperature during rewarming was longer over time, indicating a slower rate of recovery reaching significance for the comparison of 1-3 months versus 10-18 months (< 0.05). The dynamic thermal responses were examined to determine the effects of depth and dermal involvement for superficial and mixed IHs among subjects less than 18. The AUC during rewarming decreased over time for both types, but values were consistently higher for mixed IHs with significant differences at 4-6 ($P < 0.01$) and 7-9 months ($P < 0.05$). The temperature reduction with cooling decreased for mixed and was relatively stable for superficial IHs over time with differences at 4-6 and 7-9 months ($P < 0.05$ and $P< 0.05$, respectively). The rate of recovery slowed with increasing age for mixed IH but was similar for superficial IH for the first six months. Mixed IHs recovered more quickly than superficial IHs at 1-3 months ($P < 0.05$).

Treatment effects were assessed for a very small subset with multiple visits over time (seven propranolol, six untreated). The AUCrw generally decreased over time for propranolol and increased for untreated IHs.

Conclusions:

Dynamic IR thermography was used to assess vascular function and thereby provide physiological information about the IH status and disease progression. The rapid response after a cold stress indicates higher perfusion and/or vascularization shortly after birth suggesting an overall proliferative status. After 18-36 months, the time of recovery increases, i.e., is slower, presumably due to a reduction in perfusion from tumor involution and replacement with fatty tissue. The behavior is influenced by the depth of the lesion suggesting greater vascularity for the mixed IHs in this study. The dynamic IR method shows great promise for objective quantitation IH progression and therapeutic response and as a method to assist clinicians in planning treatments for this condition.

P21

Non-invasive contrast enhanced fluorescent imaging

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Keyword: Fluorescent imaging, contrast enhancement, Lock in technique, ICG

1. Introduction

The fluorescent imaging of cells and rodents has some limitations since small amount of fluorescent signal and large background noise. We have introduced the contrast enhanced specific fluorescence signals from background by using Lock in imaging method.

2. Methods

All experiments were performed using Lock in imaging system. The Lock in imaging system was composed of CCD cameras and computerized control systems. We used fluorescent dye (Indocyanine green : ICG) and Balb/c nude mice and lock in imaging technique for contrast enhanced fluorescent signal. The low fluorescent imaging acquired using the ICG diluted soution.

3. Results

The lock in imaging system improved the imaging in tissue phantom and in vivo fluorescent signal, where background fluorescence can be high. In this study, we were able to obtain small amount of fluorescent dye with in mice using proposed method.

4. Conclusion

We examined the lock-in imaging of fine fluorescent model for noise eliminated detection method. It has been shown that lock-in imaging method which was earlier used for non-destructive estimate of buried defects in materials that can be used on a biomedical imaging for failure analysis in bio material as fine fluorescent detection.

P22

See abstract in O10 podium session.