Transfert de l'imagerie Multiphoton en clinique

MICROSCOPIE MULTIPHOTON:
Regroupe un ensemble de processus liés aux effets non linéaires

⇒ Plusieurs modes de contraste dans des échantillons biologiques

- Fluorescence endogène : TPF
- Génération de signaux particuliers : SHG et THG

⇒ Visualisation simultanée et sans marqueur des fibres d'élastine et de collagène de la matrice extra cellulaire

- FLIM : durées de vie des fluorophores endogènes (ou exogènes)

L'imagerie MultiPhoton en essais clinique depuis plusieurs années

First clinical studies based on **multimodal multiphoton** tomography including the combination with dermoscopy, ultrasound, confocal reflectance microscopy, and OCT have been conducted in the Department of Dermatology of the University Jena in February, 2009.

First clinical **CARS tomography in combination with multiphoton autofluorescence/SHG** tomography have been performed at the Charite in Berlin in the spring of 2010.

K. Koenig . IntraVital 1:1, 11–26; (2012)

Applications en dermatologie

Guidage des biopsies
et aide à la délimitation des marges chirurgicales

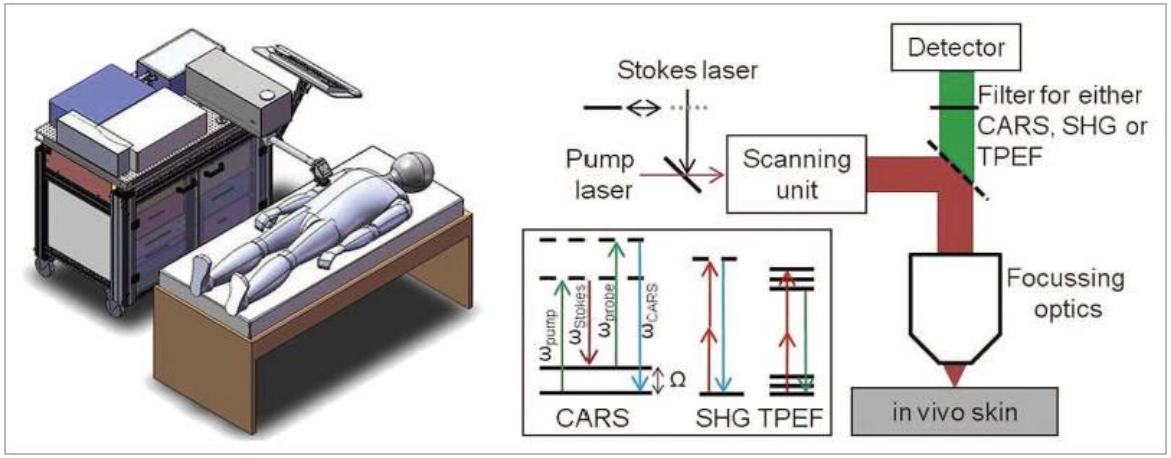
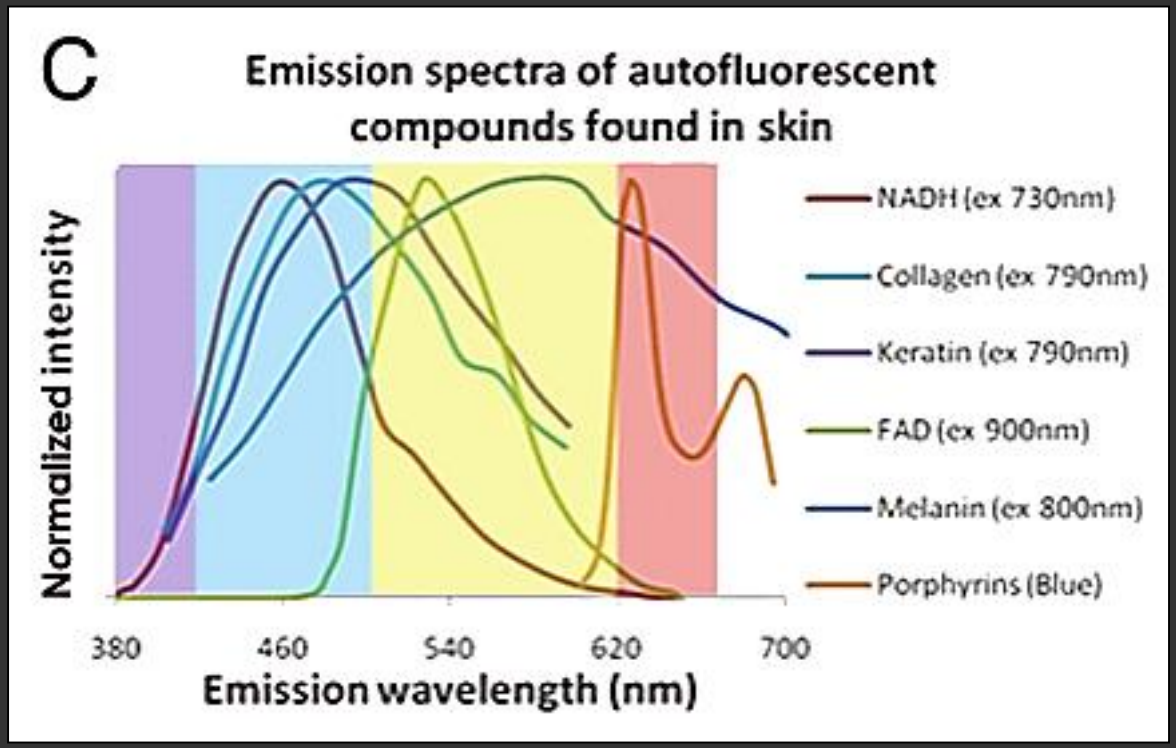


Figure 3. Multiphoton hybrid tomograph MPT-CARS for lipid/water imaging by CARS, detection of NAD(P)H, flavins, keratin, elastin and melanin by two-photon autofluorescence as well as collagen imaging by SHG.[27,28]

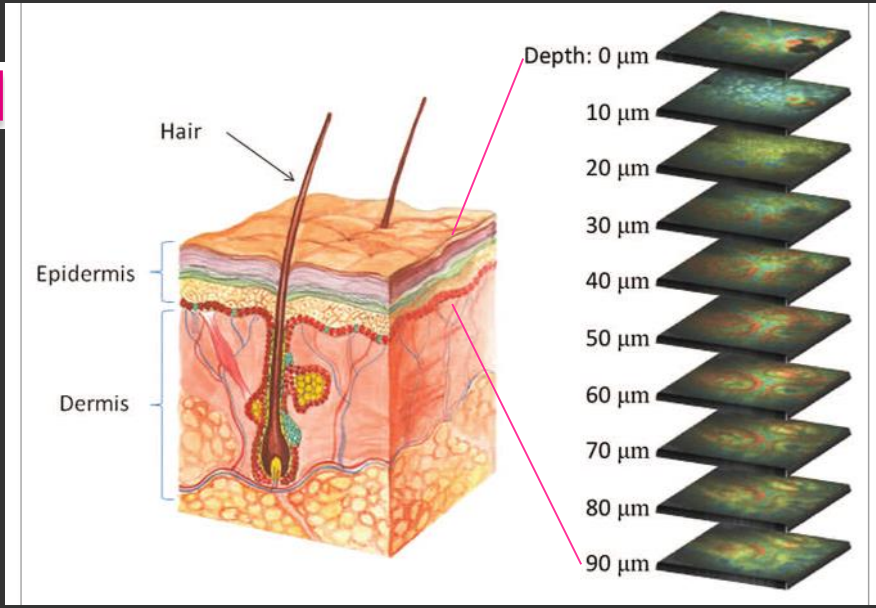
Figure 2. Multiphoton-tomograph DermaInspect™ at the University of Münster, Germany. The 3D imaging system can be expanded to a 5D tomograph by adding a spectral FLIM module.

K. Koenig . IntraVital 1:1, 11–26; (2012)

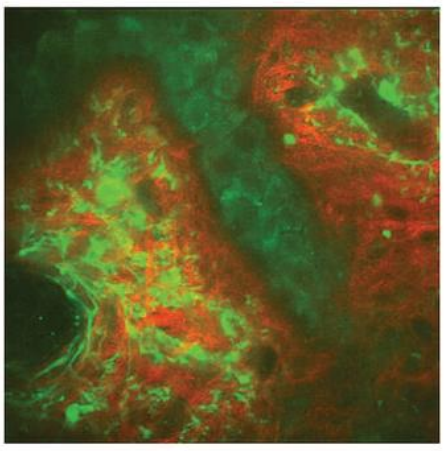


K. Koenig . IntraVital 1:1, 11–26; (2012)

GUSTAVE ROUSSY
CANCER CAMPUS
GRAND PARIS

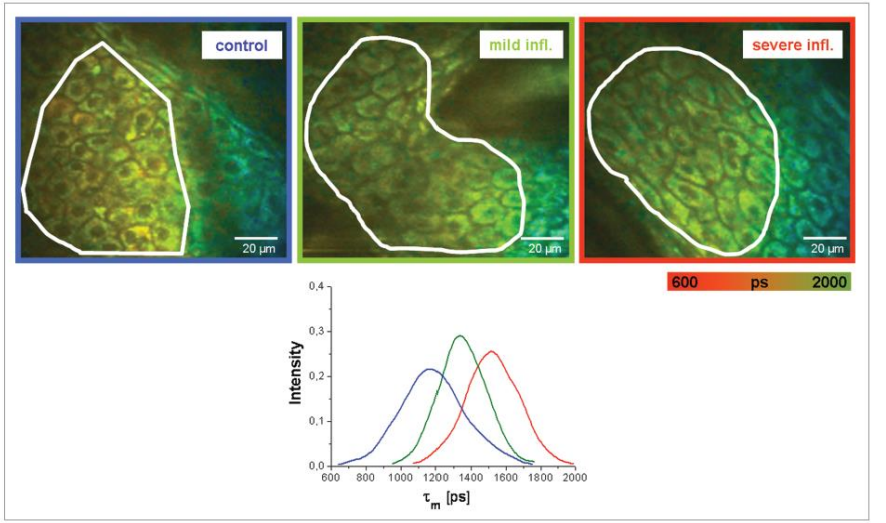


Multiphoton sections out of an optical biopsy of the left arm of a male volunteer



TPF + SHG

FLIM



FLIM analyses from the upper epidermis with NAD(P)H and flavoproteins as endogeneous fluorophores

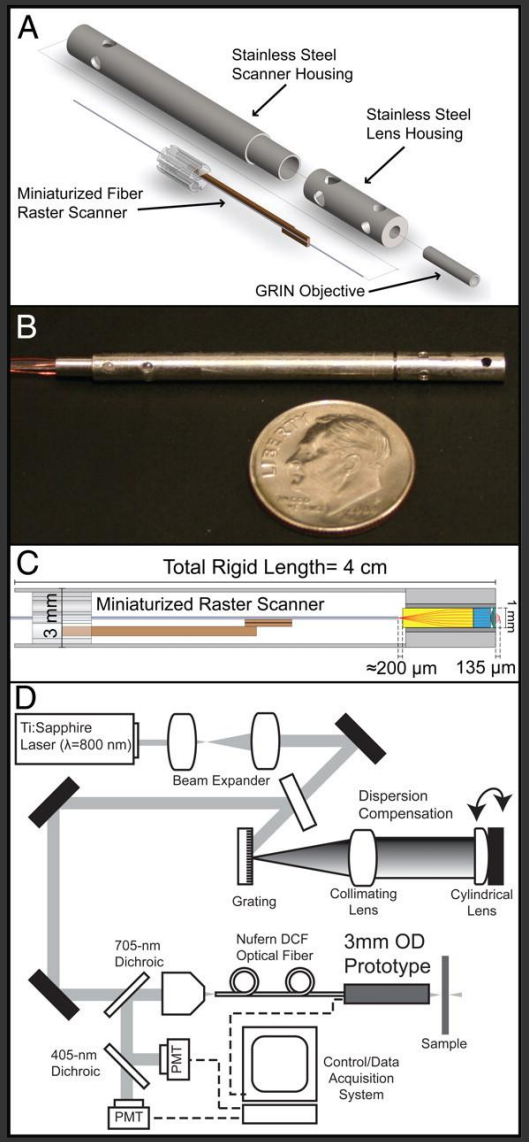
Figure 11. Clinical FLIM images during the treatment of patients suffering from dermatitis show a clear correlation between the mean autofluorescence lifetime and the grade of the disease (SCORAD). Healthy skin (blue) has a shorter mean fluorescence lifetime than skin areas with "mild" dermatitis (green) and severe disease (red). Successful treatment results in shortening of the mean fluorescence lifetime.[26]

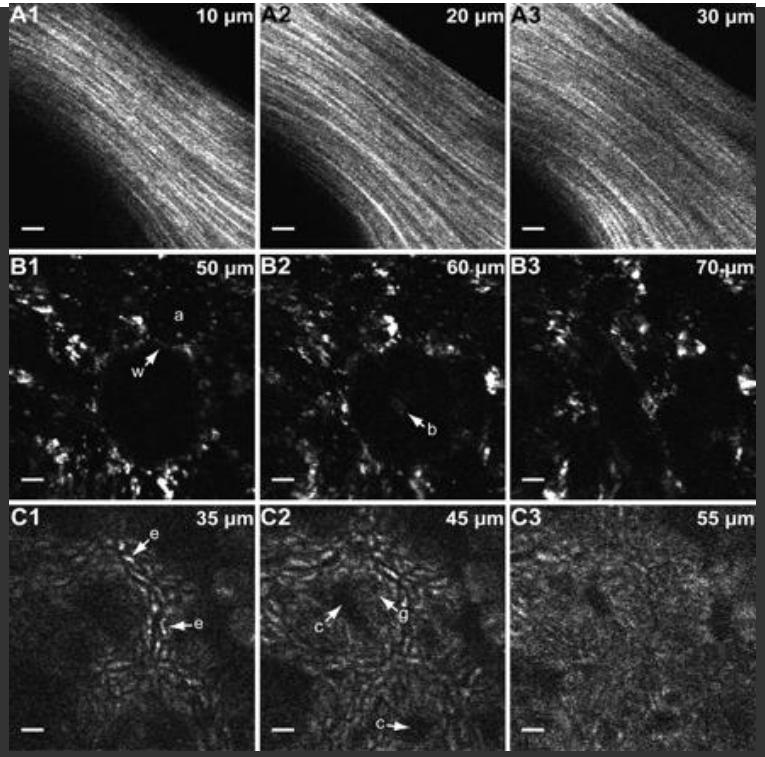
Clinical trial : USE OF MULTIPHOTON MICROSCOPY IN THE DIAGNOSIS OF CANCER (*Weill Cornell Medical College. NY-USA)*

- Assessment of the ability of Multiphoton Microscopy in the identification of various diseases.
- No specimen treatment (e.g., dyes or other contrast agents) from the outside.
- Analyze on removed organ specimens (bladder, prostate, testis, kidney, lung, colon or thyroid) before it is analyzed by the Pathology Department
- Patients eligible for the study are undergoing either a cystoscopy including a Transurethral Resection of Bladder Tummor (TURBT), a nephrectomy, prostatectomy, colon resection of colectomy, thyroidectomy, or lobectomy.

https://www.cornellurology.com/resources/clinical-trials/cancer-trials/

Multiphoton Microendoscopy





TPF/SHG images of **ex vivo mouse** tissue. (*A*) Unaveraged SHG images of mouse tail tendon at 10, 20, and 30 µm from the surface. (*B*) Unaveraged intrinsic fluorescence images of mouse lung at 50, 60, and 70 µm from the tissue surface (*C*) Five frames averaged intrinsic fluorescence images of mouse colon at 35, 45, and 55 µm from the surface. In *C*1, enterocytes (e) are visible; in *C*2, crypts (c) and goblet cells (g) are present. Scale bars, 10 µm. All images were acquired at 4.1 frames/second,

DR Rivera - (2011). PNAS. vol. 108 no. 43