



PHOTOACOUSTICS FOR CLINICAL DIAGNOSTICS

Professor Malin Malmjö
Lund University, Sweden

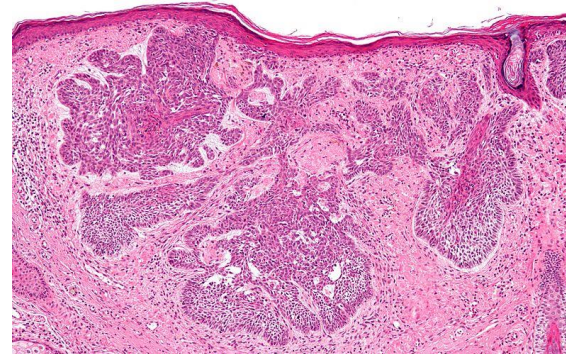
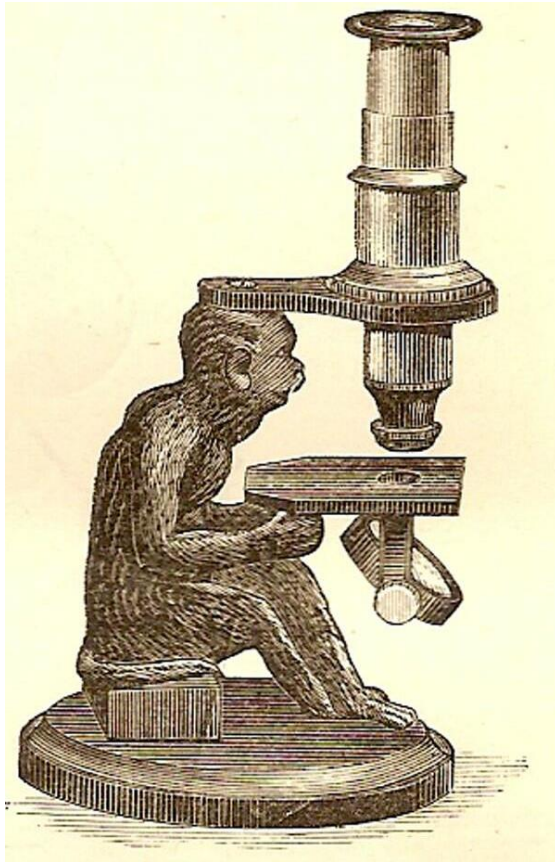
No Disclosures



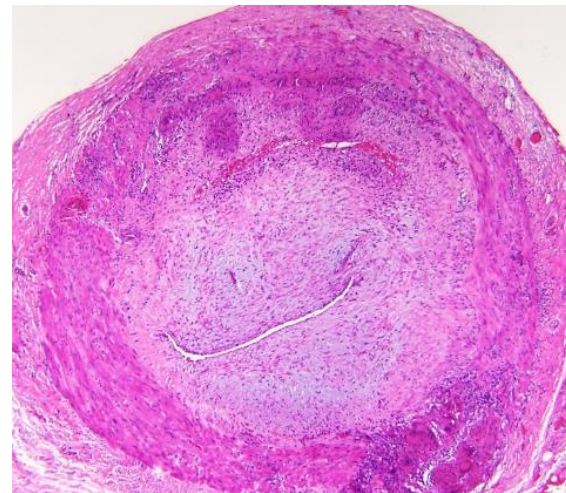
Empirical knowledge using existing techniques



Histology for diagnosis of tumors and giant cell arteritis



Basal cell carcinoma



Giant cell arteritis



Photoacoustic imaging research team

Clinical research at Skåne University Hospital



Experimental research at Biomedical Center, Lund University

Experimental research on pigs



Clinical research in patients



Faculty of Engineering

Light



Nina Reistad, Associate Professor
at the Department of Physics,
Lund University

Sound



Magnus Cinthio, Associate Professor
at the Department of Biomechanics,
Lund University

Tumor margins

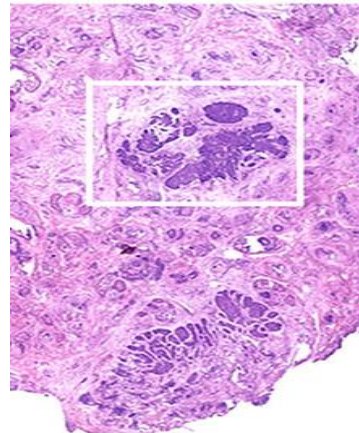
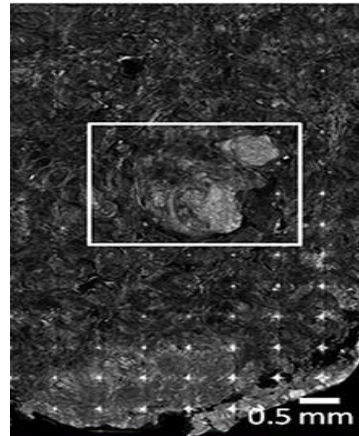


Existing technique – Dermatoscopy



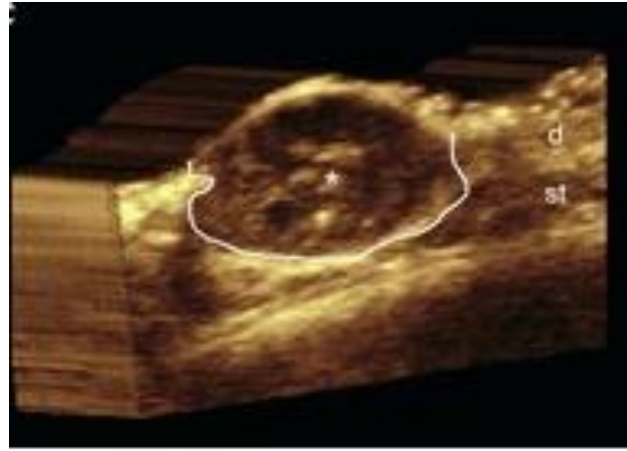
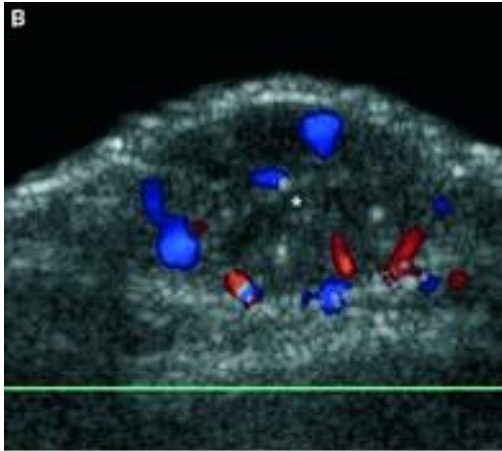
- Visual / low resolution
- Subjective method
- Long learning curve

Existing technique – Confocal microscopy



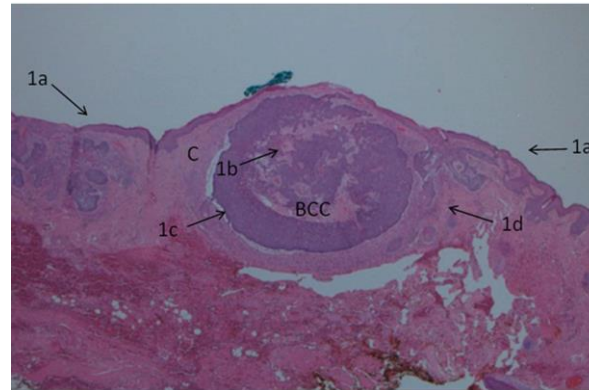
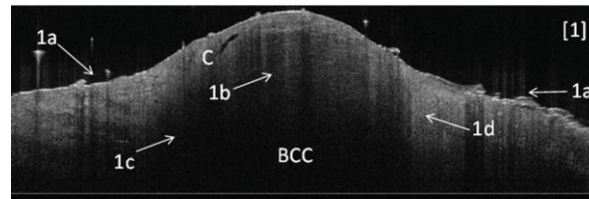
- Histology-like images
- High resolution
- Laser focused to one depth that gives an image from one plan
- Superficial images (0.1-0.2 mm down)
- Small areas (1x1 mm)
- Requires immersion cup

Existing technique – High frequency ultrasound



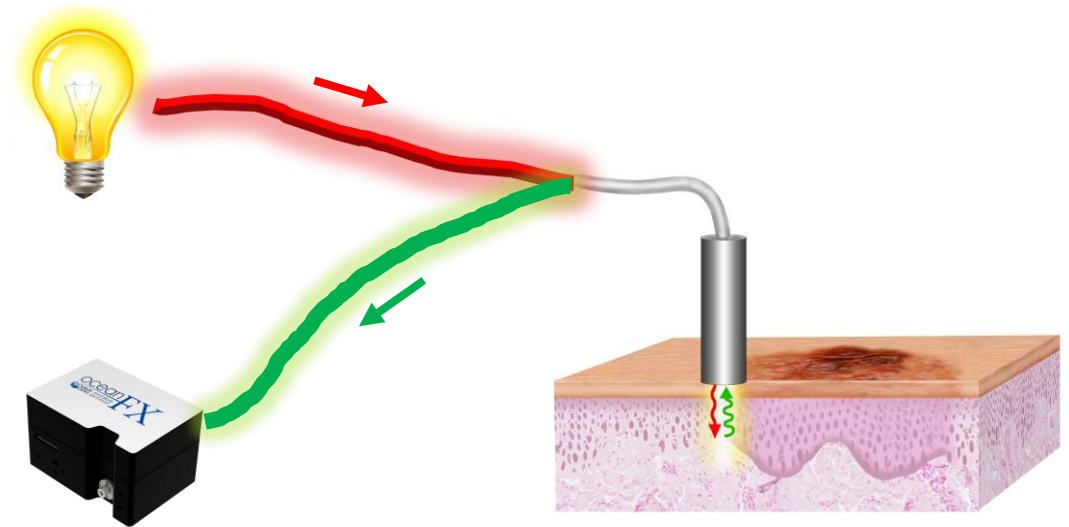
- Deeper
- Inferior resolution
- Difficult to discriminate from inflammation, scar tissue, etc.

Existing technique – OCT



- High resolution (though not as high as for confocal microscopy)
- Limited depth (1-2 mm)

Diffuse reflectance spectroscopy

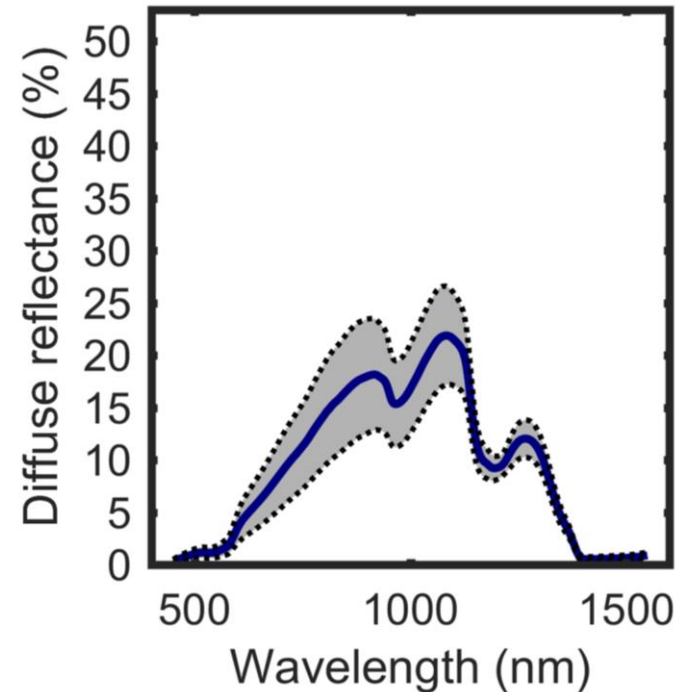
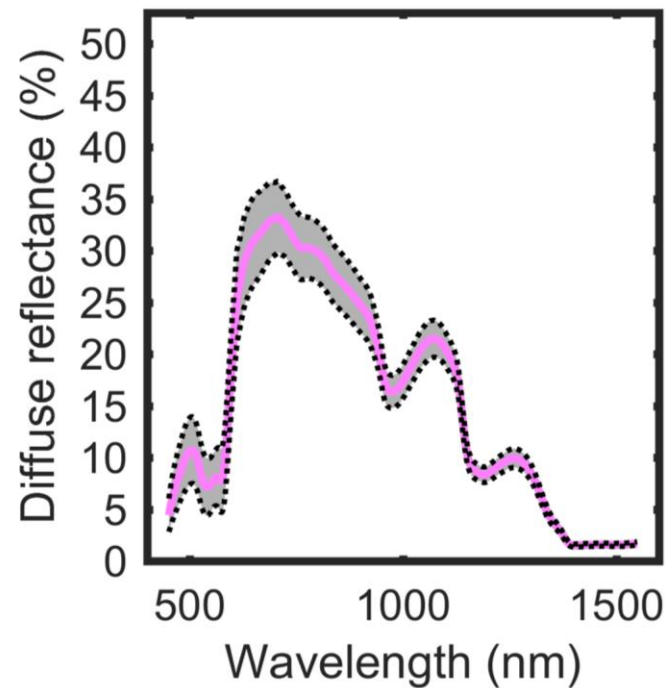


Diffuse reflectance spectroscopy

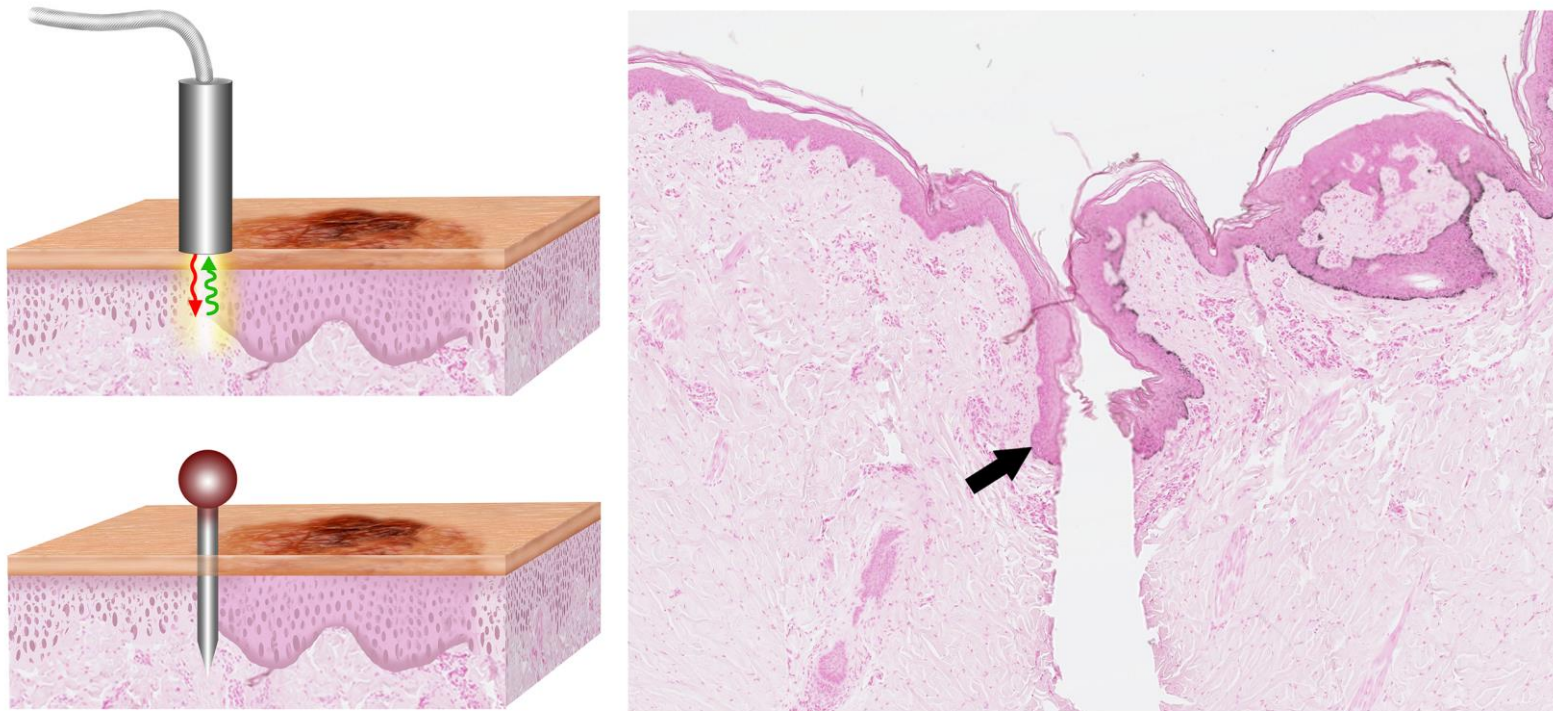
Broad wavelength spectrum between 450 and 1550 nm



Optic fingerprint

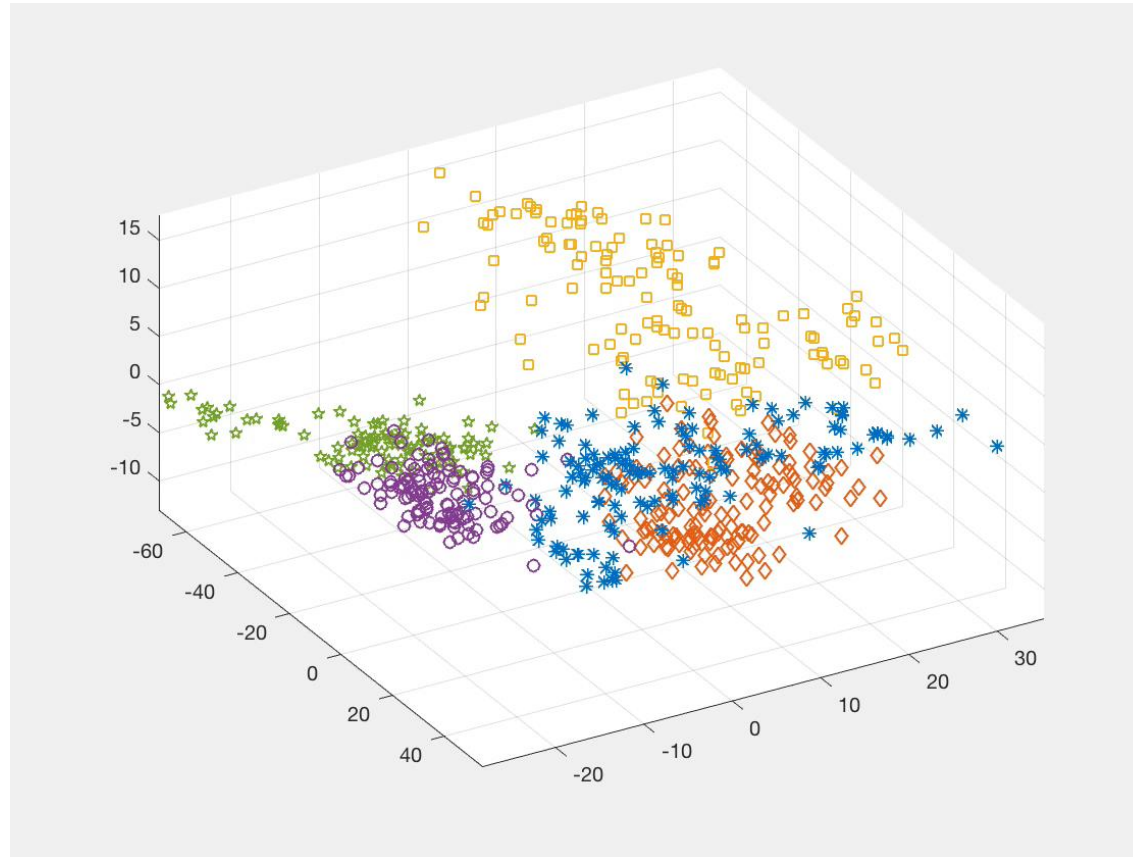


Diffuse reflectance spectroscopy



DAHLSTRAND, U., SHEIKH, R., NGUYEN, C. D., HULT, J., REISTAD, N. & MALMSJO, M.
Identification of tumor margins using diffuse reflectance spectroscopy with an
extended-wavelength spectrum in a porcine model. *Skin Res Technol.* 2018.

Diffuse reflectance spectroscopy



DAHLSTRAND, U., SHEIKH, R., NGUYEN, C. D., MEMARZADEH, K., REISTAD, N. & **MALMSJÖ, M.** 2018. Developing an extended-wavelength diffuse reflectance spectroscopy technique with a machine-learning method for future non-invasive tumor margin delineation, using an experimental pig model. *EPlasty*. In press

Photoacoustic imaging



IBLA

IngaBritt och Arne Lundbergs
Forskningsstiftelse

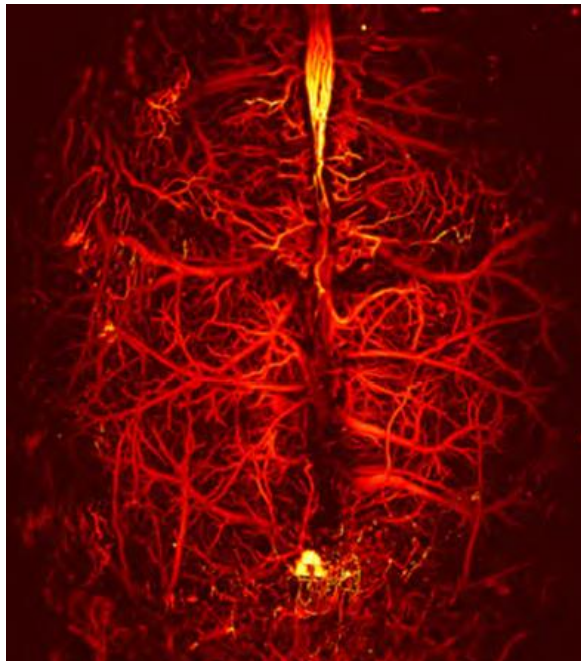


Photoacoustic imaging

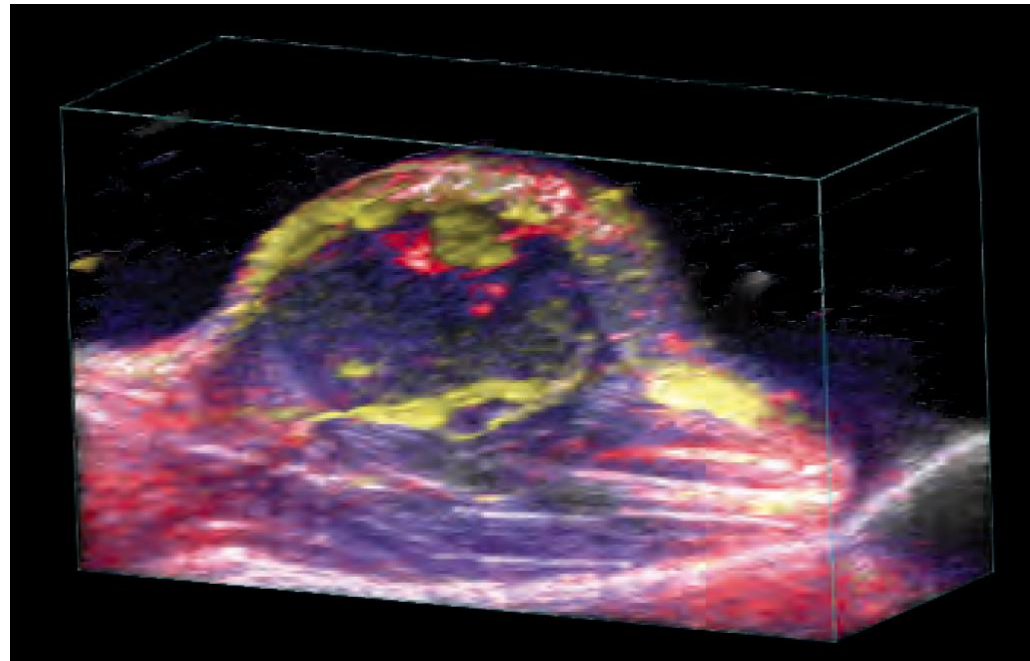


Photoacoustic imaging – structure and function

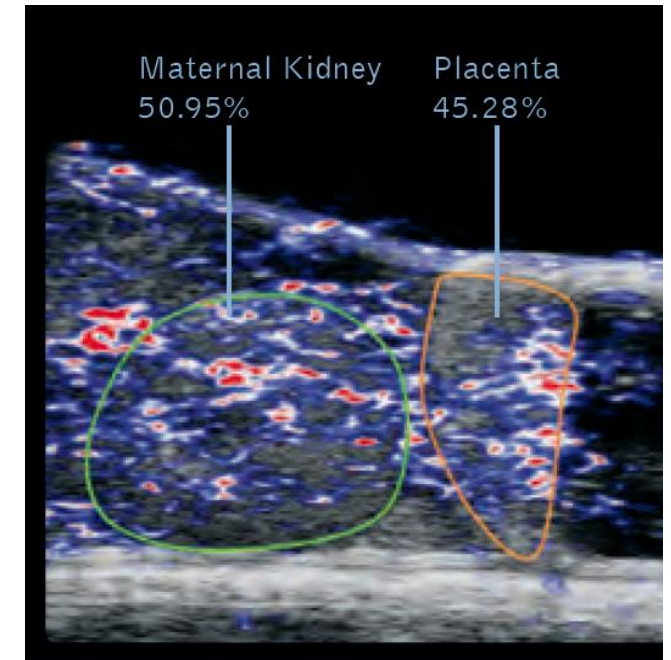
Vasculature



Tumors



Oxygen saturation



Clinical translation of a novel photoacoustic imaging system



SHEIKH, R., DAHLSTRAND, U., REISTAD, N., ERLÖV, T., CINTHIO, M. & MALMSJÖ, M. 2018. Clinical translation of a novel photoacoustic imaging system for non-invasive diagnostics. *IEEE*. 2018

Tumor examination with PAI

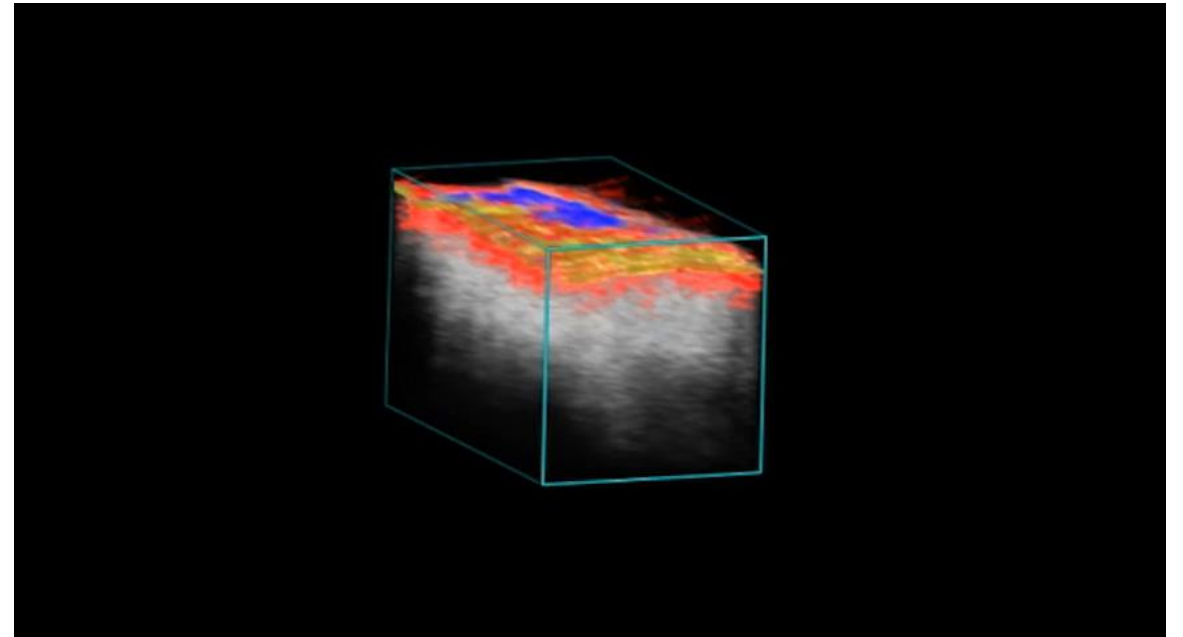
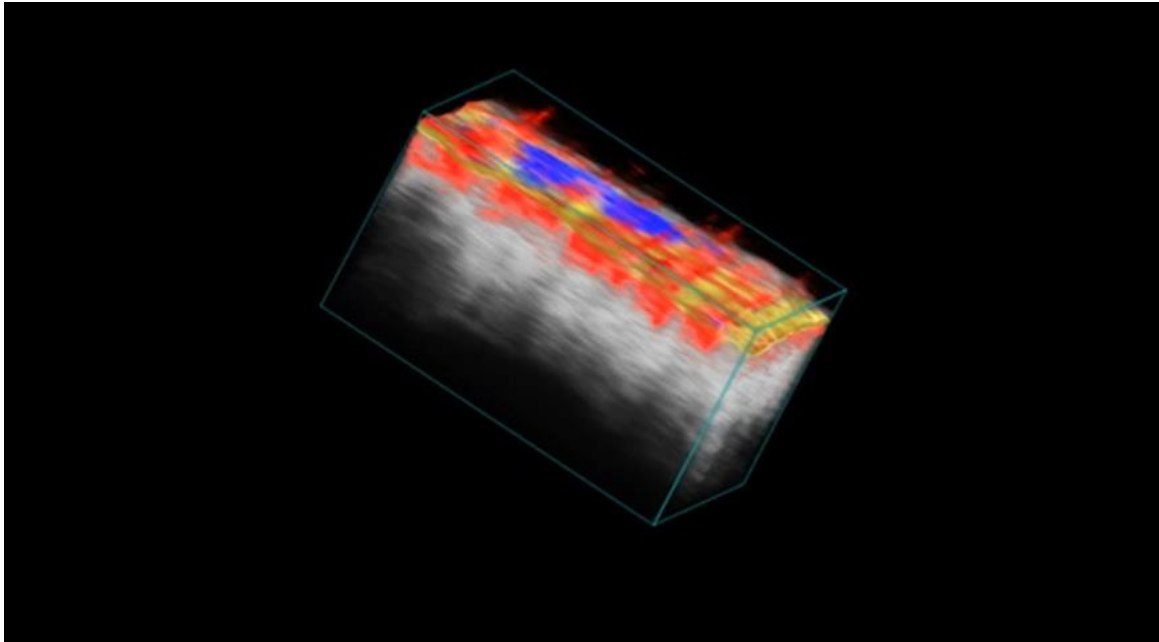
In vivo



Ex vivo

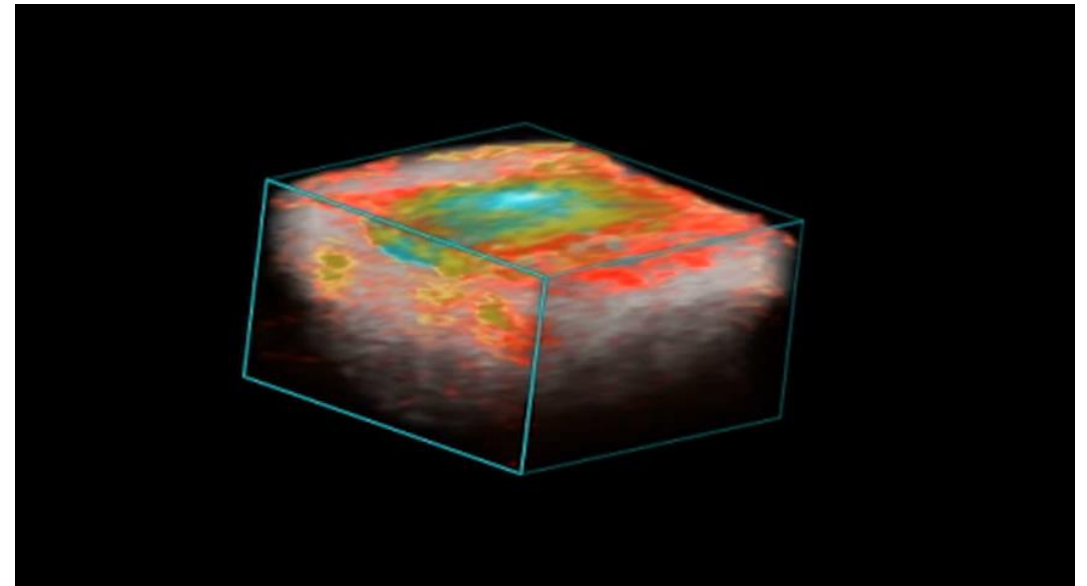
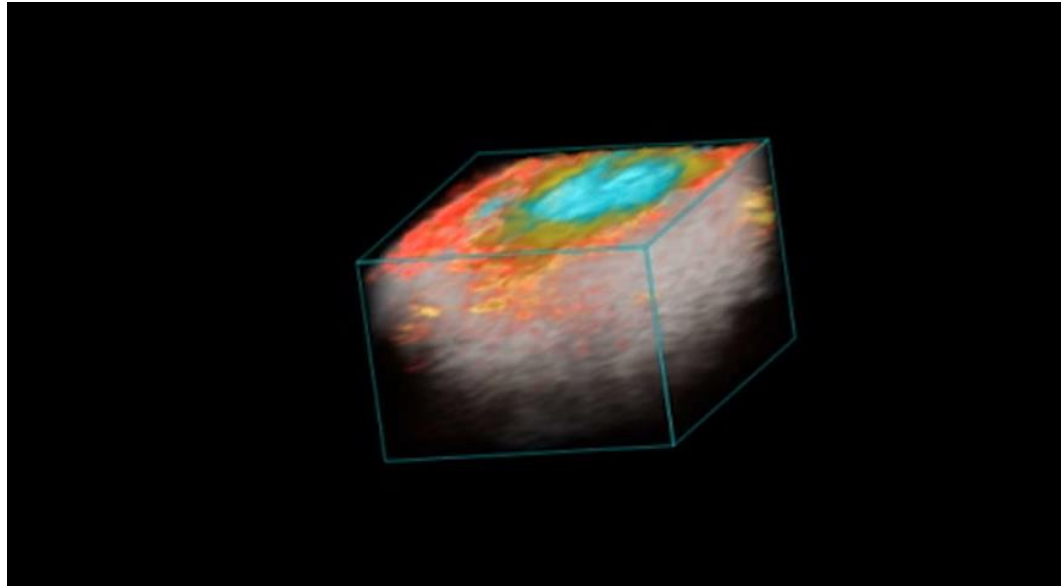


Lentigo maligna melanoma

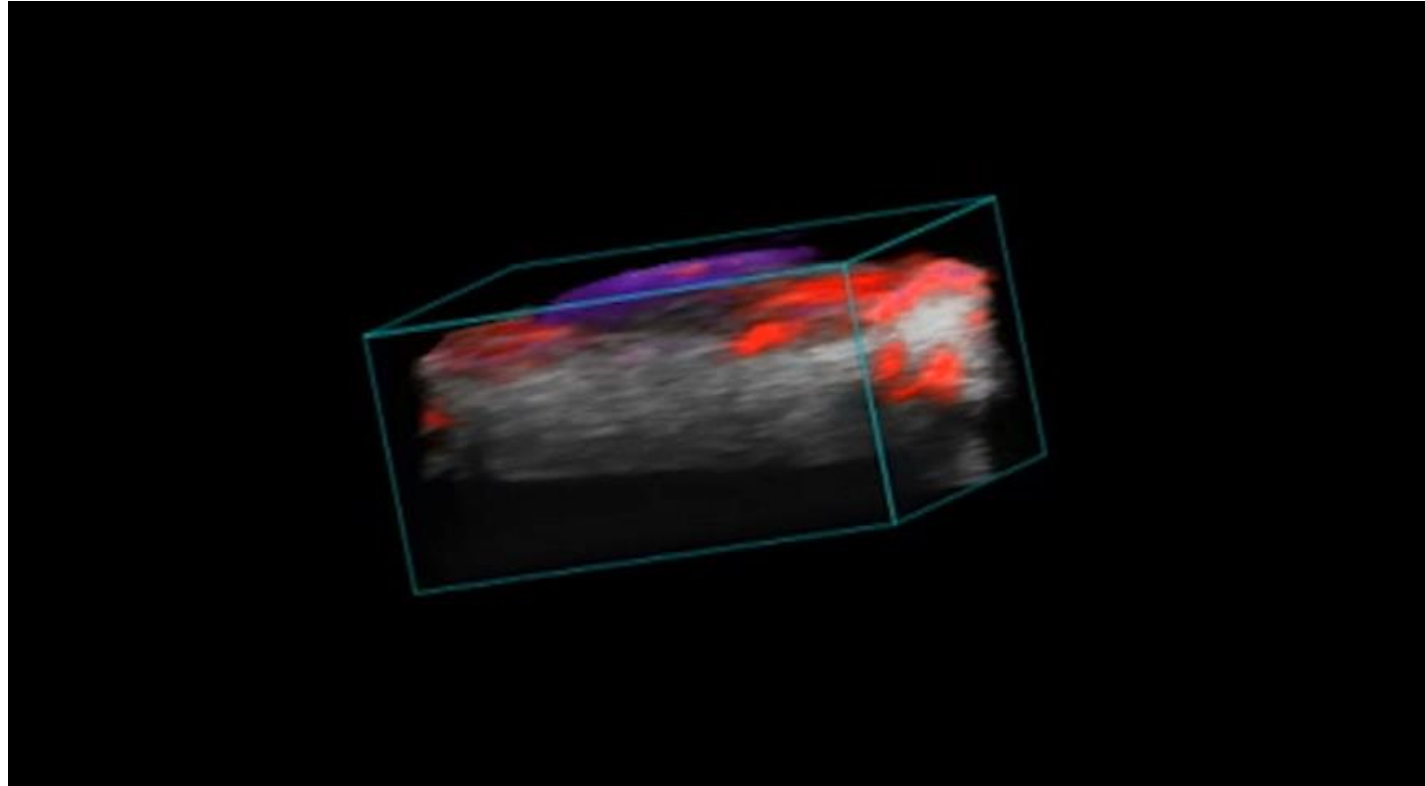


Blue = lentigo maligna melanoma

Squamous cell carcinoma

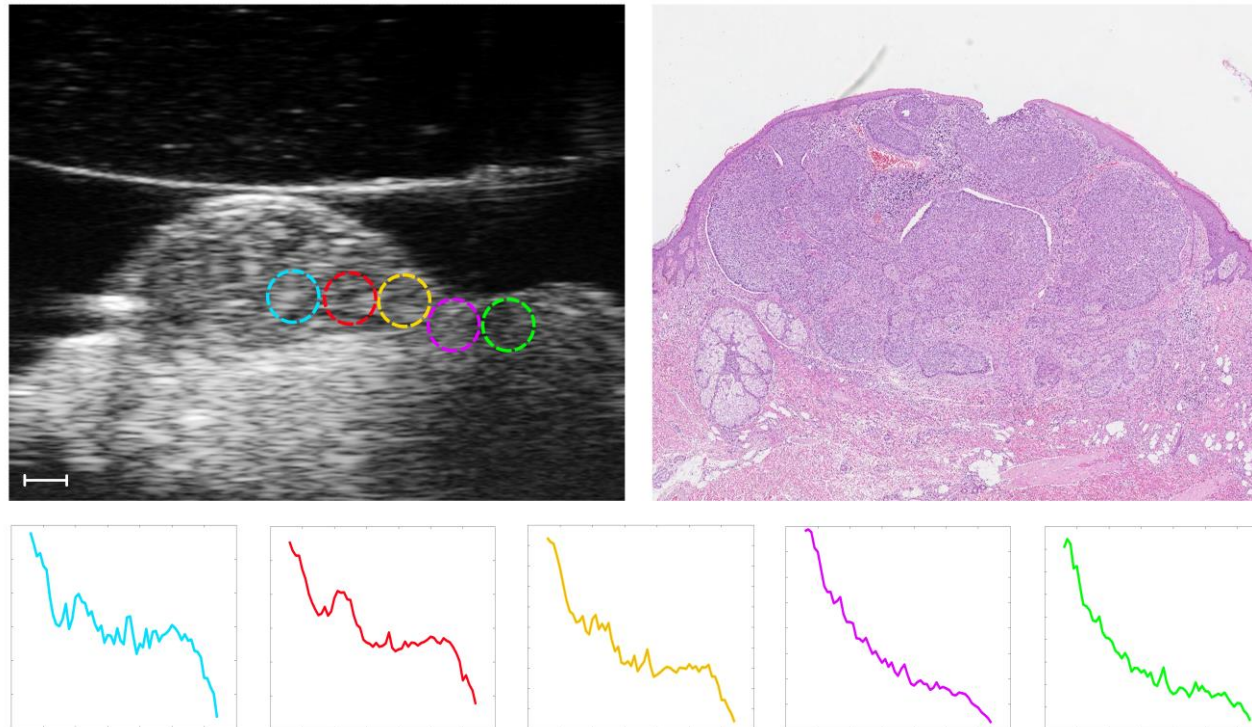


Basal cell carcinoma

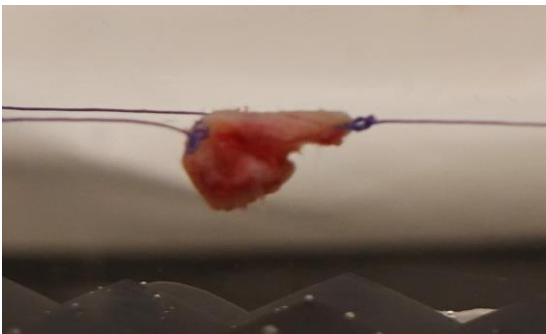
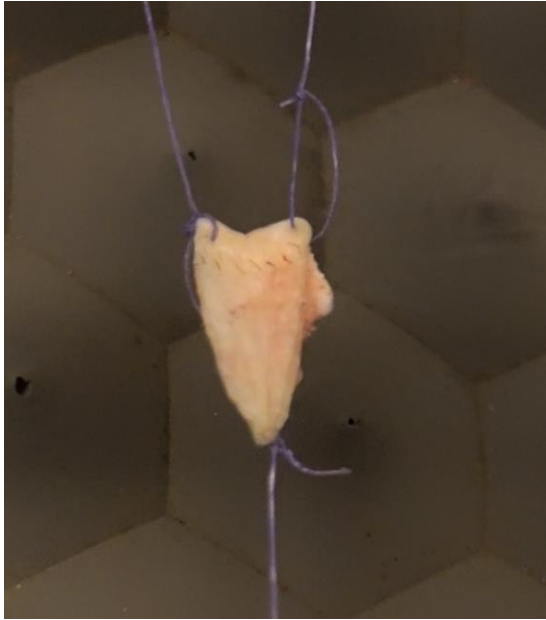


Violet = basal cell carcinoma

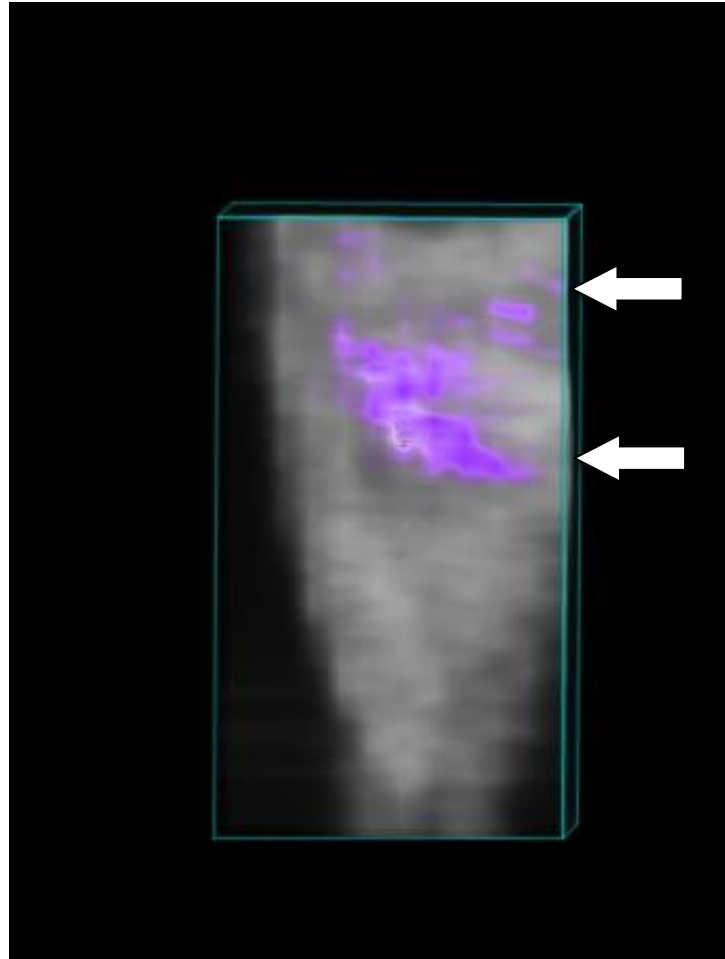
Basal cell carcinoma



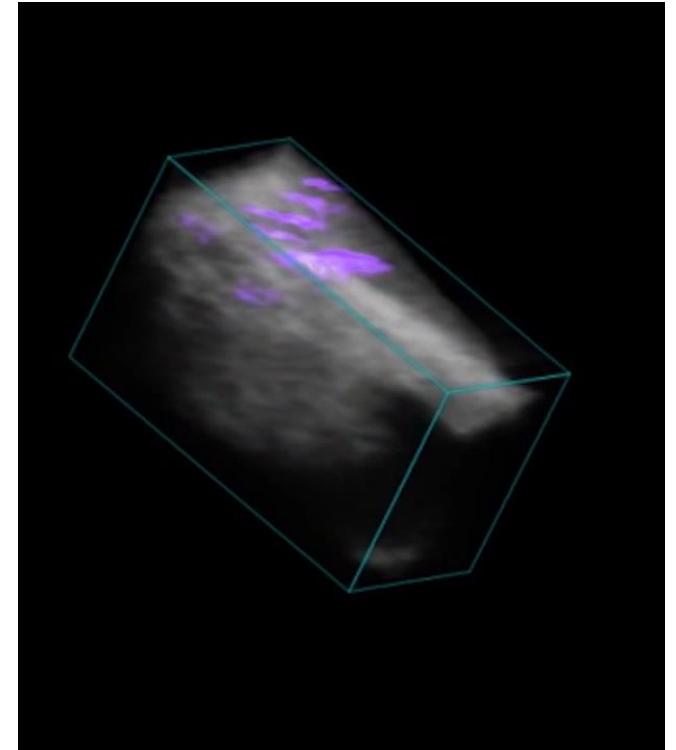
Basal cell carcinoma in an eyelid



Barely visible BCC



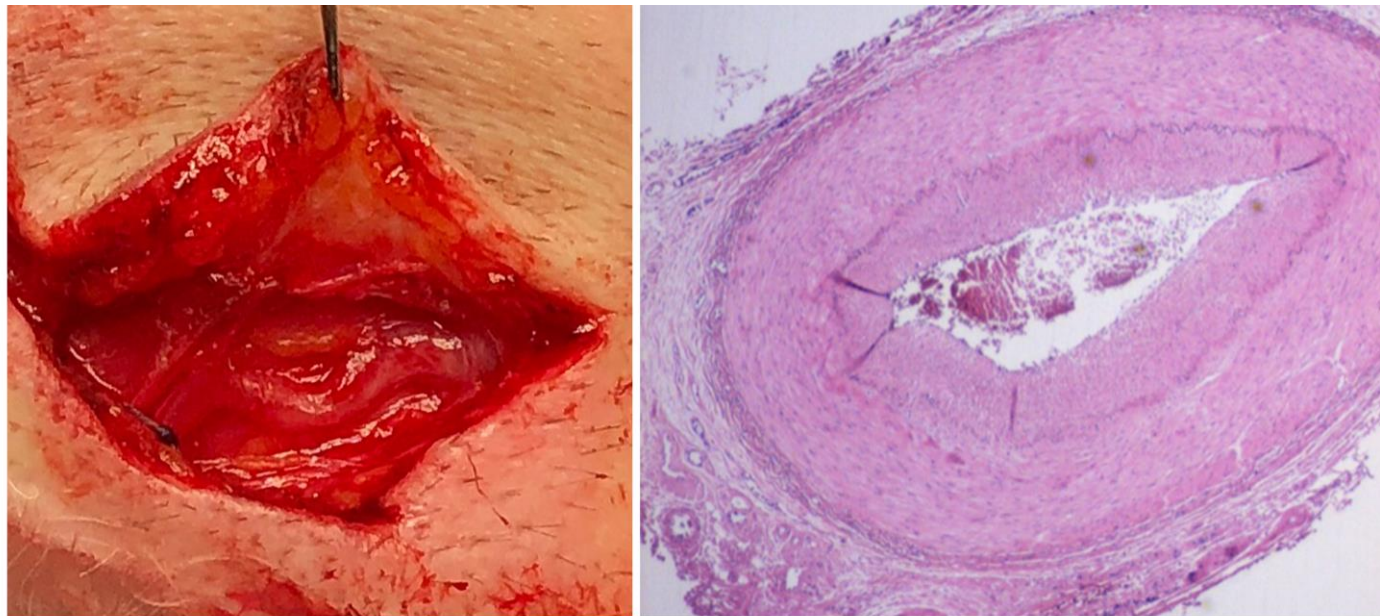
Non-radical excision



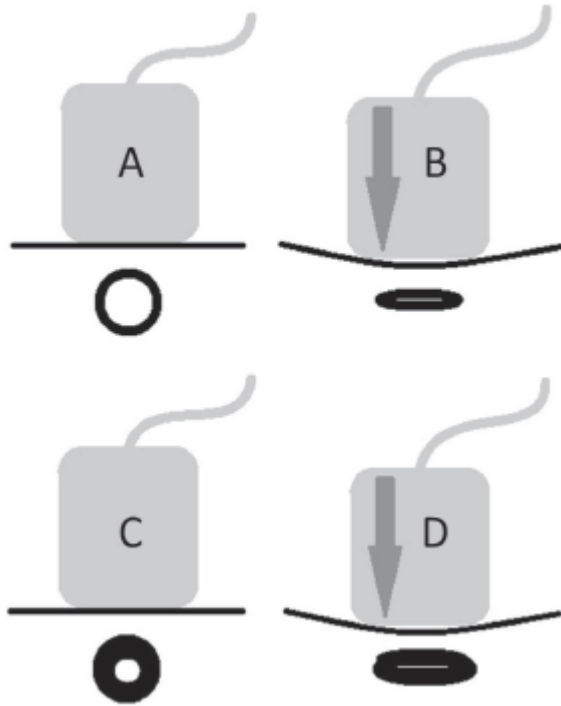
Giant cell arteritis



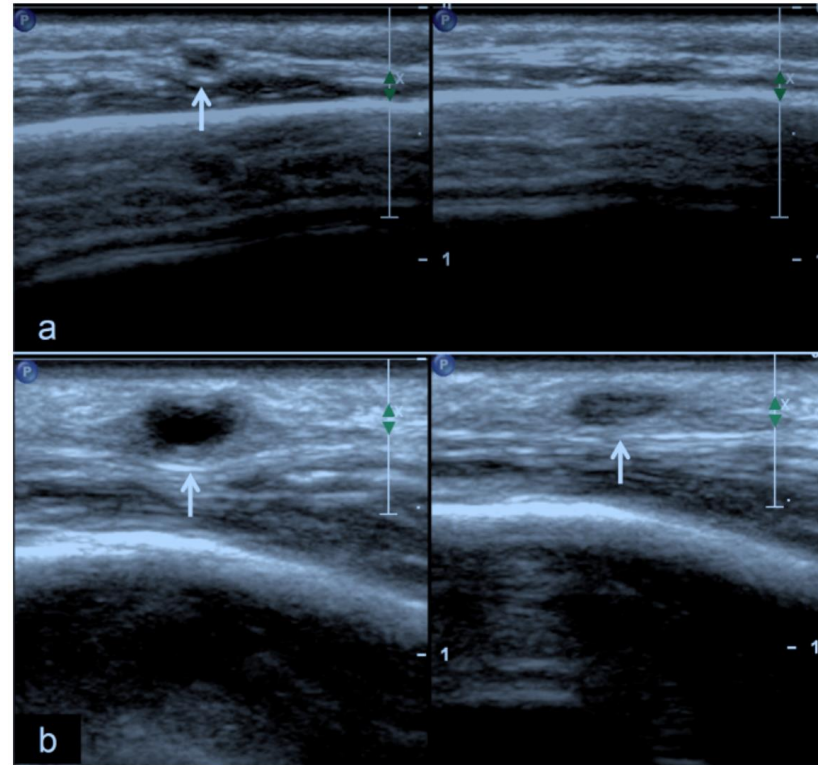
Giant cell arteritis – surgical biopsy



Ultrasound – compression sign



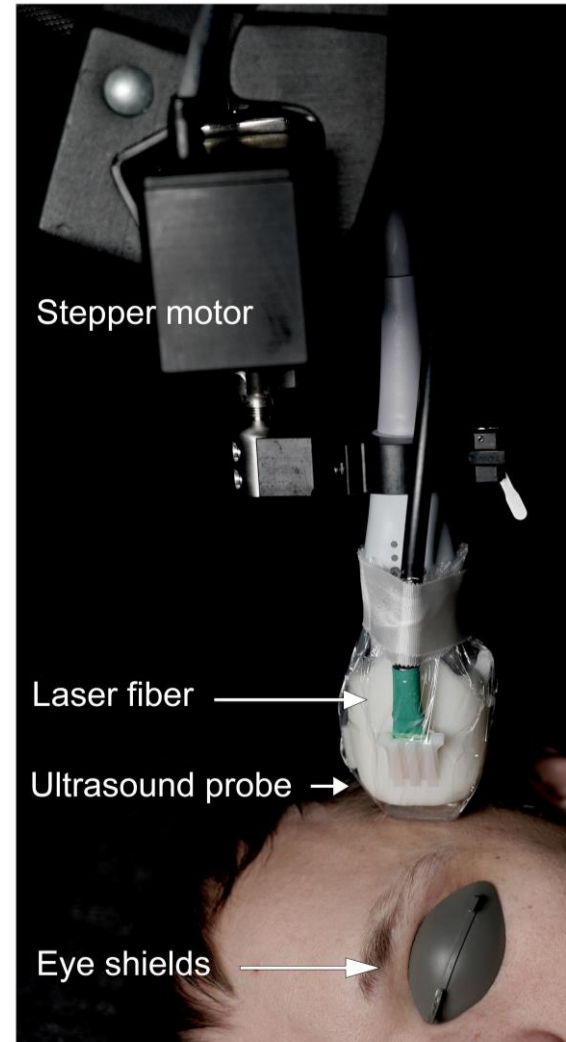
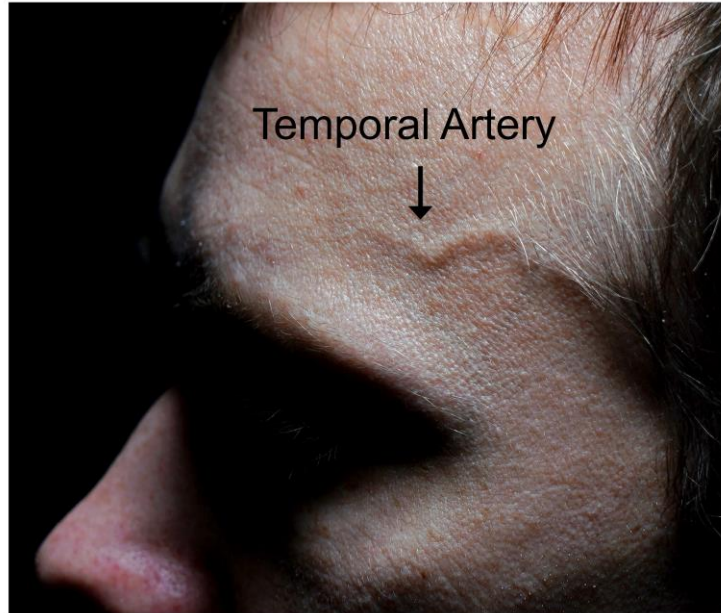
Czihal 2017



Aschwanden 2013

1. Aschwanden et al. Temporal artery compression sign--a novel ultrasound finding for the diagnosis of giant cell arteritis. *Ultraschall Med.* 2013 Feb;34(1):47-50
2. Czihal et al. *Clin Exp Rheumatol* 2017; 35 (Suppl. 103):S128-133

Temporal artery examination with PAI

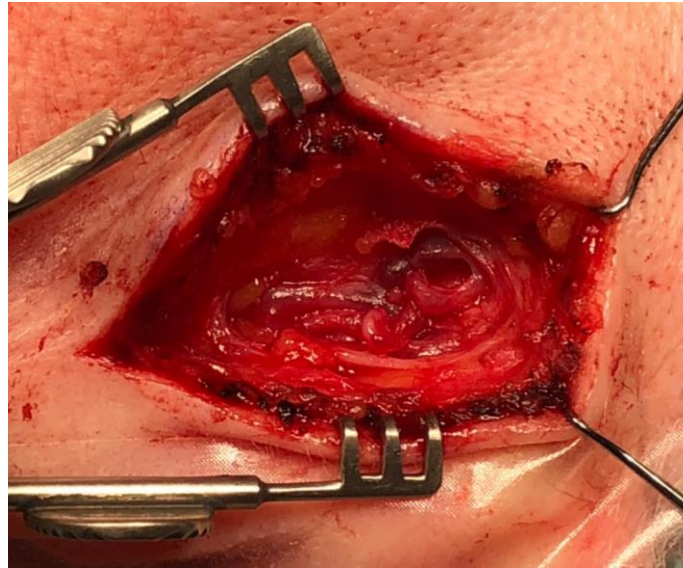


Temporal artery examination with PAI

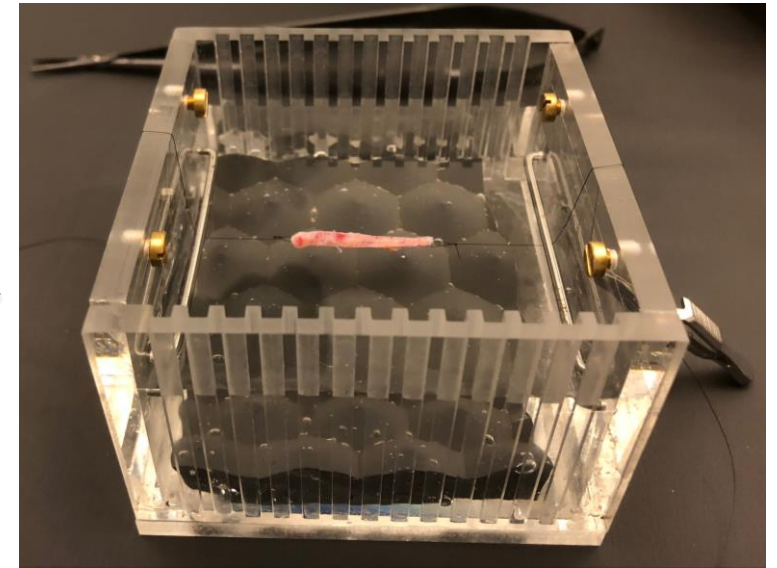
In vivo PAI



Surgery



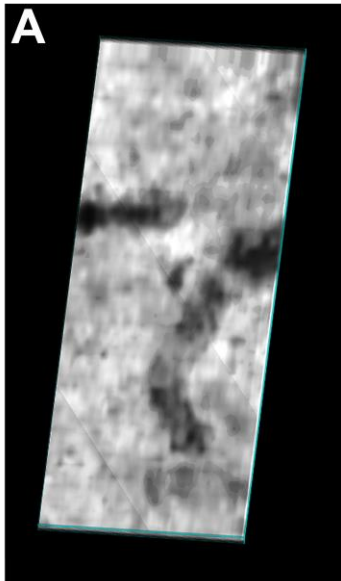
Ex vivo PAI



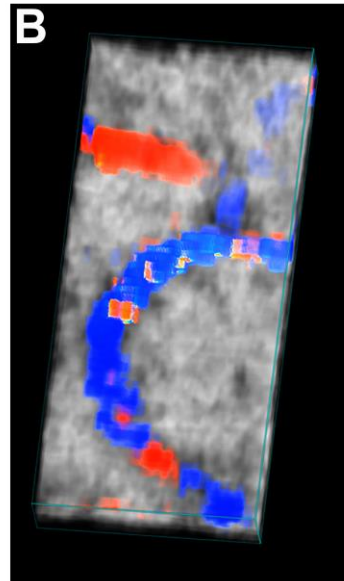
SHEIKH, R., DAHLSTRAND, U., REISTAD, N., ERLÖV, T., CINTHIO, M. & MALMSJÖ, M. 2018. Clinical translation of a novel photoacoustic imaging system for non-invasive diagnostics. *IEEE*. 2018

Temporal artery examination with PAI

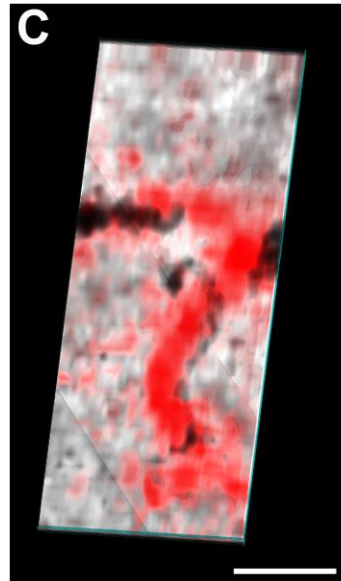
Ultrasound



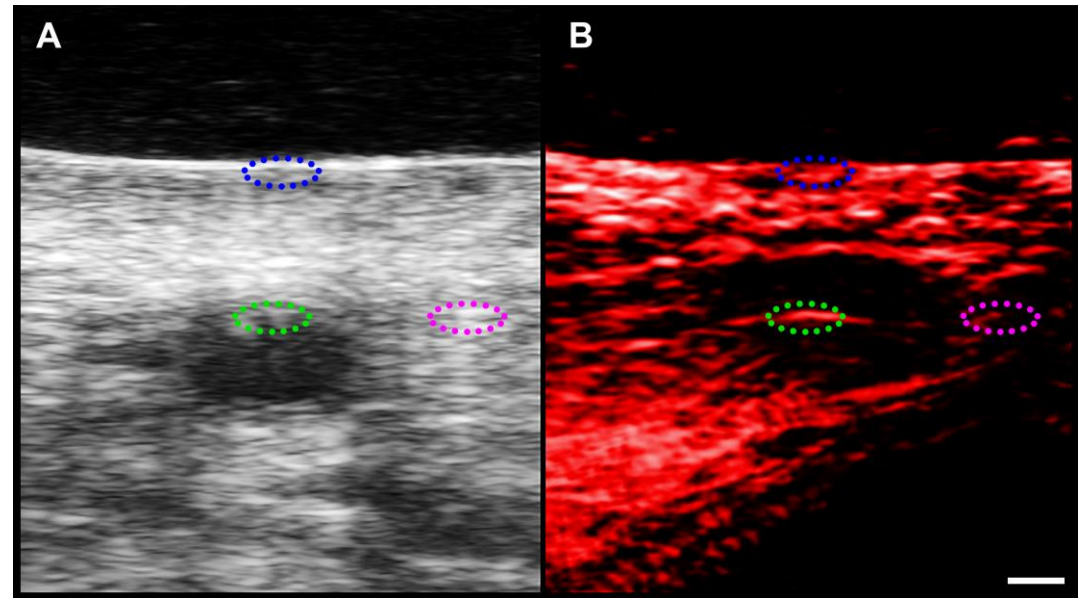
Doppler



Photoacoustics



Measuring absorption spectrum in the artery wall



Photoacoustic imaging research team

Senior Consultants and Researchers

- Rafi Sheikh (MD, PhD)
- John Albinsson (MSc, PhD)
- Bodil Gesslein (MSc, PhD)
- Björn Hammar (MD, PhD)
- Karl Engelsberg (MD, PhD)
- Jonas Blohmé (MD, PhD)
- Khashayar Memarzadeh (MD, PhD)

Department of Engineering

- Nina Reistad (senior lecturer)
- Magnus Cinthio (senior lecturer)
- Tobias Erlöv (post doc)

PhD students

- Rannveig Linda Thorisdottir (MD, specialist physician)
- Kajsa Tenland (MD, specialist physician)
- Ulf Dahlstrand (MD, resident physician)
- Cu Dinh Nguyen (MD, resident physician)
- Jenny Hult (MD, resident physician)
- Josefin Bunke (MD, resident physician)
- Johanna Berggren (MD, resident physician)
- Magdalena Naumovska (MD, resident physician)





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