

Intra-operative real-time confocal imaging-guided Mohs surgery

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Basal cell carcinomas (BCC):

> 1.2 million new cases/yr

not fatal but highly morbid

associated with subclinical extension

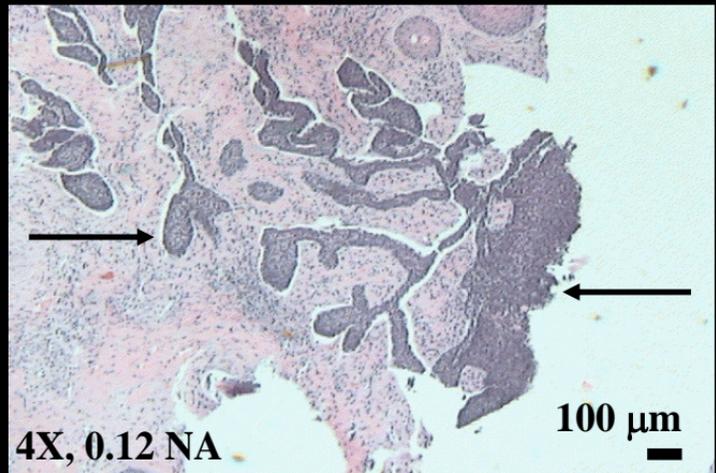
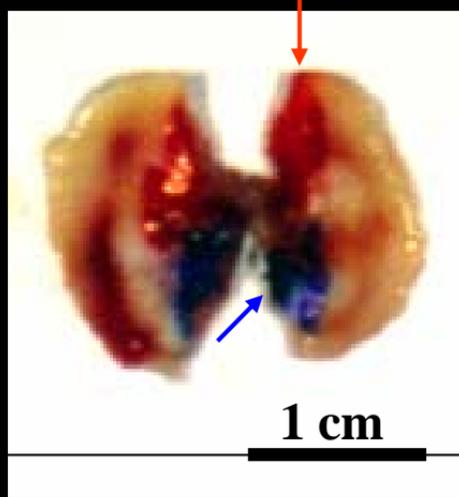
treatment costs > \$500 million/yr

Mohs micrographic surgery:

precise mapping and excision of cancer

minimal damage to surrounding normal skin

face (high risk areas: eyes, nose, ears, lips)



Sequential skin excisions

Preparation of histology

Total # excisions

Total patient waiting time

? Confocal imaging detect BCC intraoperatively, on patient, real-time ?

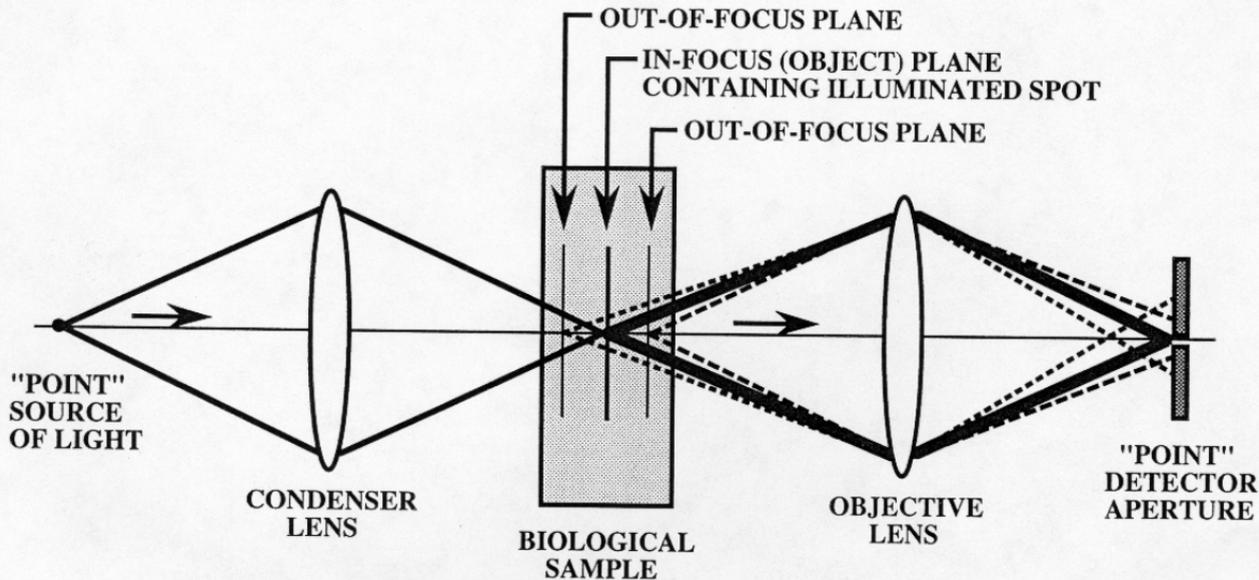


Frozen histology

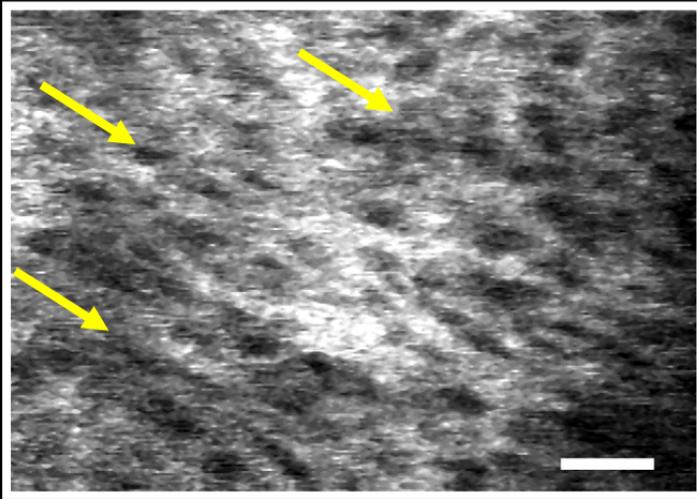
~ 20-60 minutes / excision

~ 2-4 (typical)

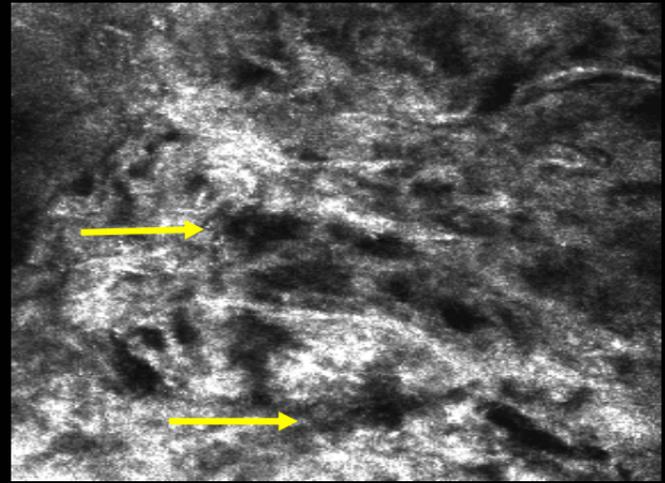
~ one to several hours



"OPTICAL SECTIONING" WITH A CONFOCAL MICROSCOPE



BCC



collagen in dermis

Nuclei in BCCs lack contrast relative to dermis

BCCs are not detectable within dermis in reflectance

Preliminary Results

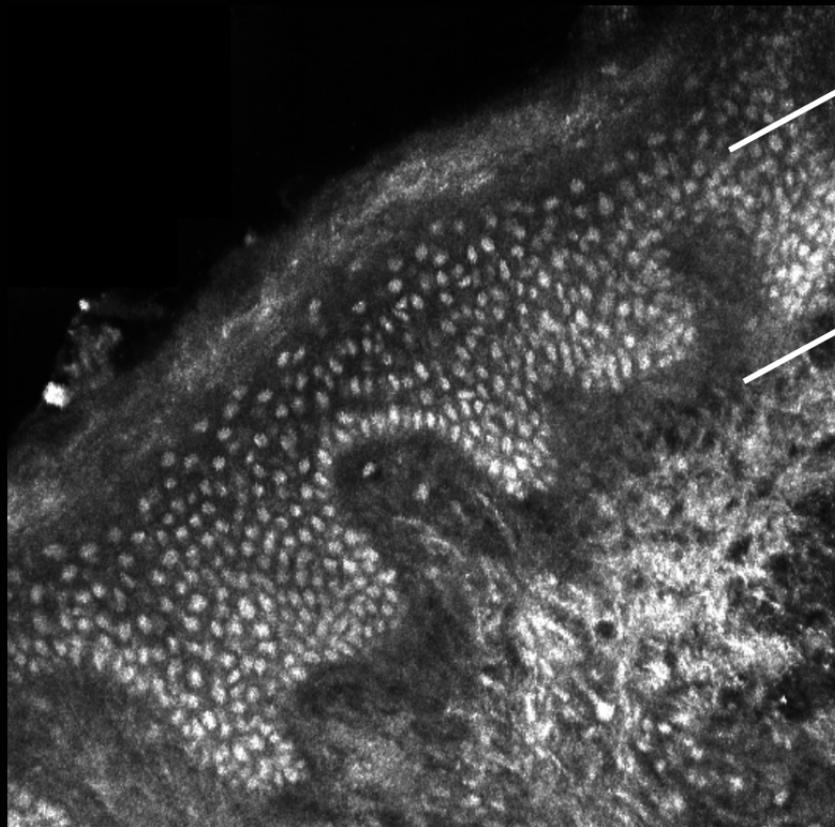
BCC may be detected using :

acetic acid (acetowhitening)

increases chromatin back-scatter, brightens nuclei

cross-polarized confocal imaging

enhances nuclei-to-dermis contrast,
makes nuclei detectable

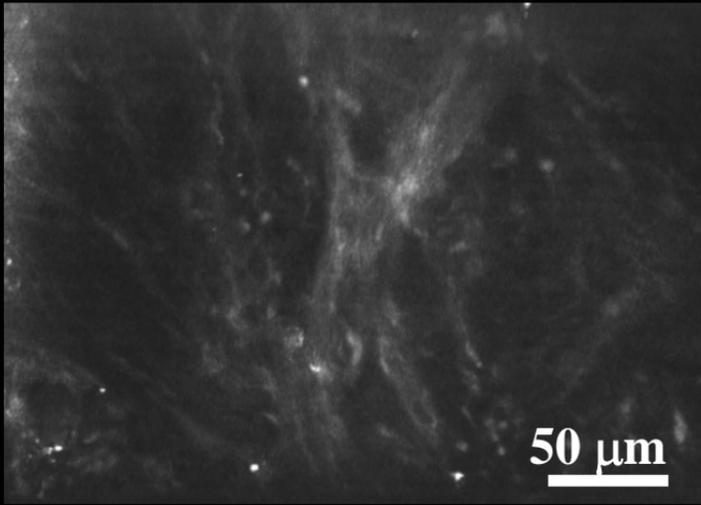


epidermis

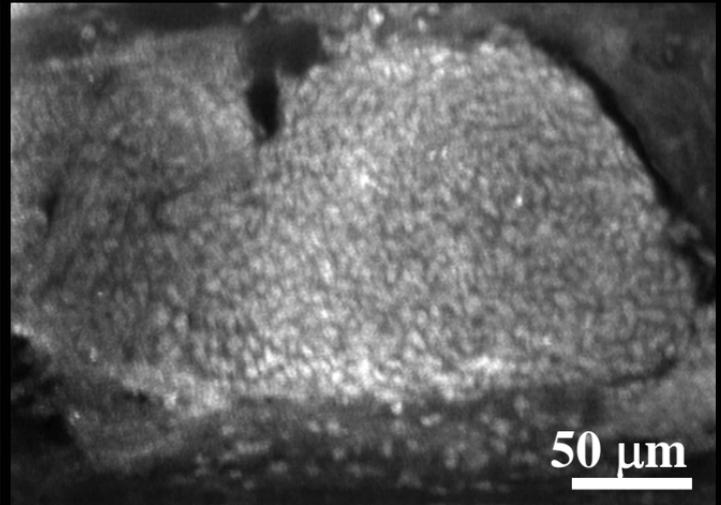
dermis

Brightfield confocal,
0.9 NA,
sectioning $\sim 2 \mu\text{m}$

5% acetic acid compacts chromatin,
brightens nuclei in epidermis



Normal dermis

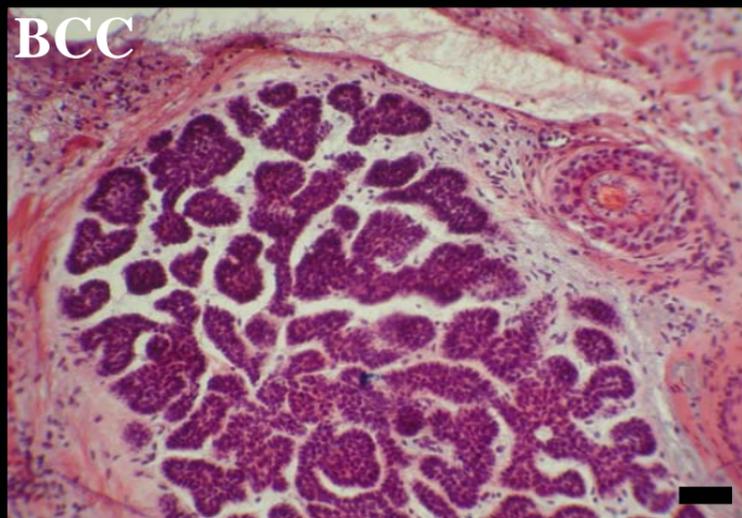
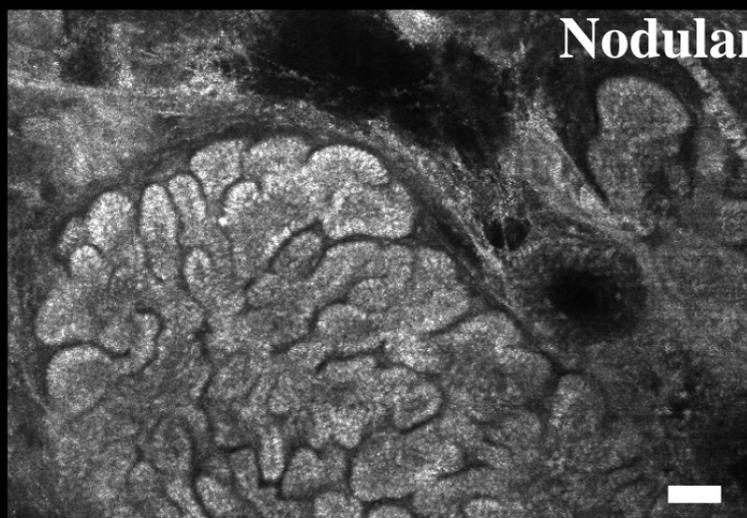


Basal cell carcinoma (BCC)

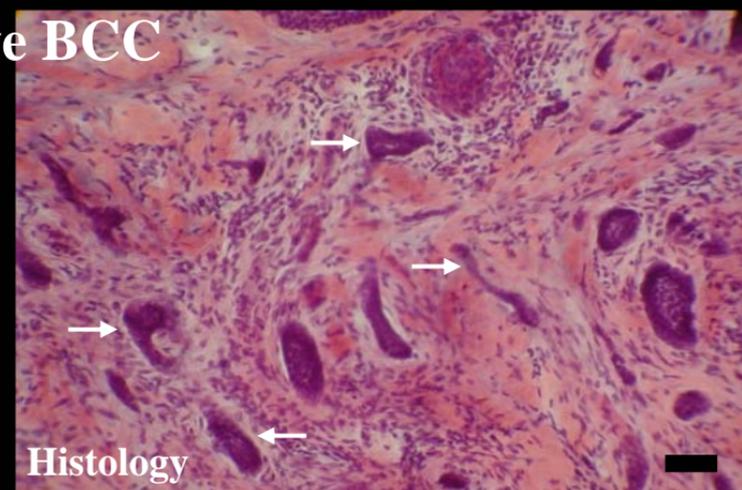
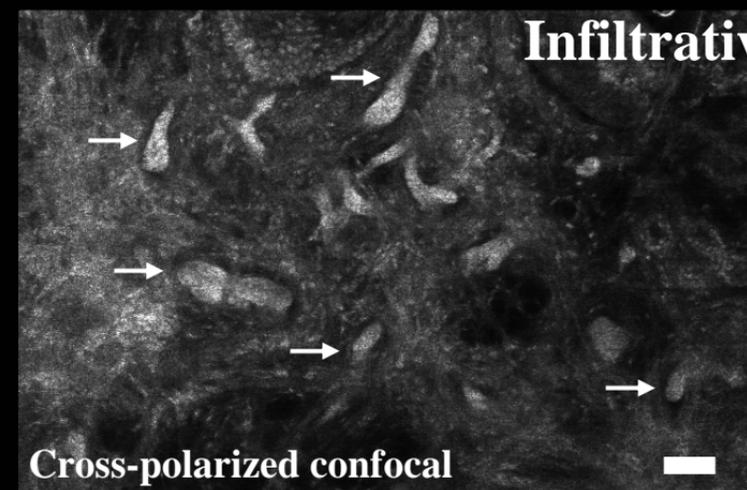
Compacted chromatin depolarizes the illumination

Crossed polarization darkens surrounding
normal dermis

Nodular BCC

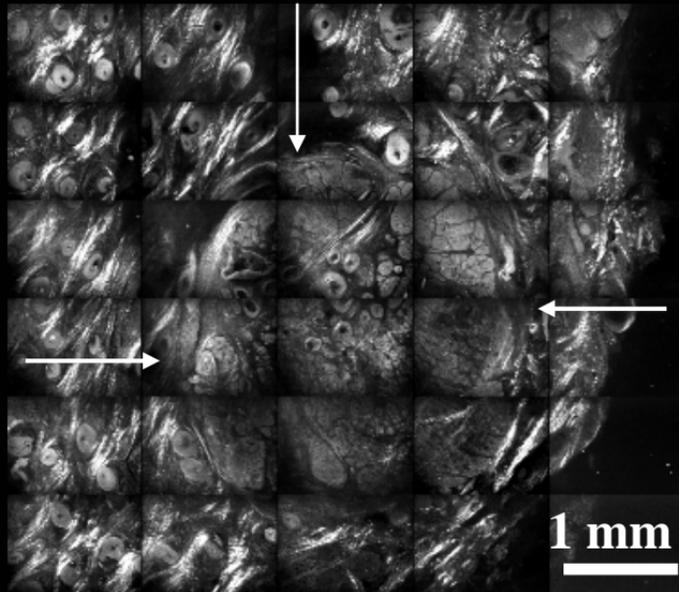


Infiltrative BCC

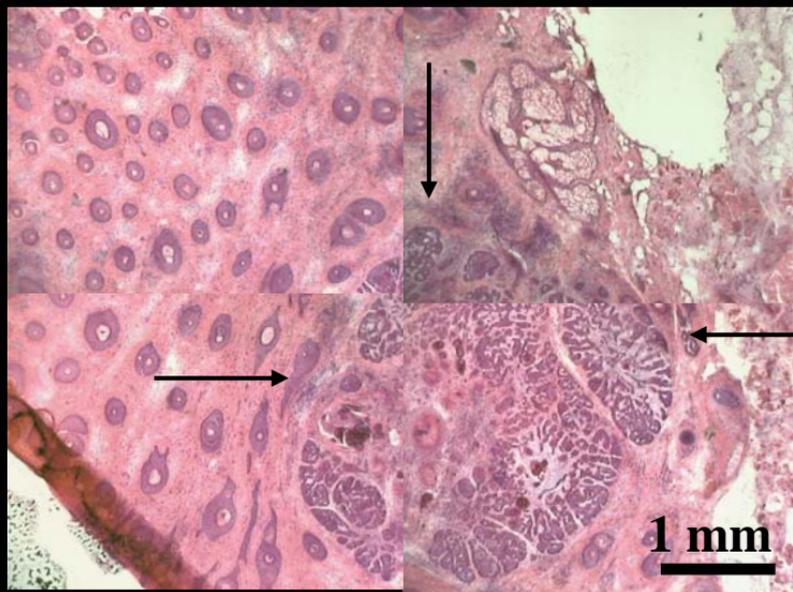


Cross-polarized confocal

Histology



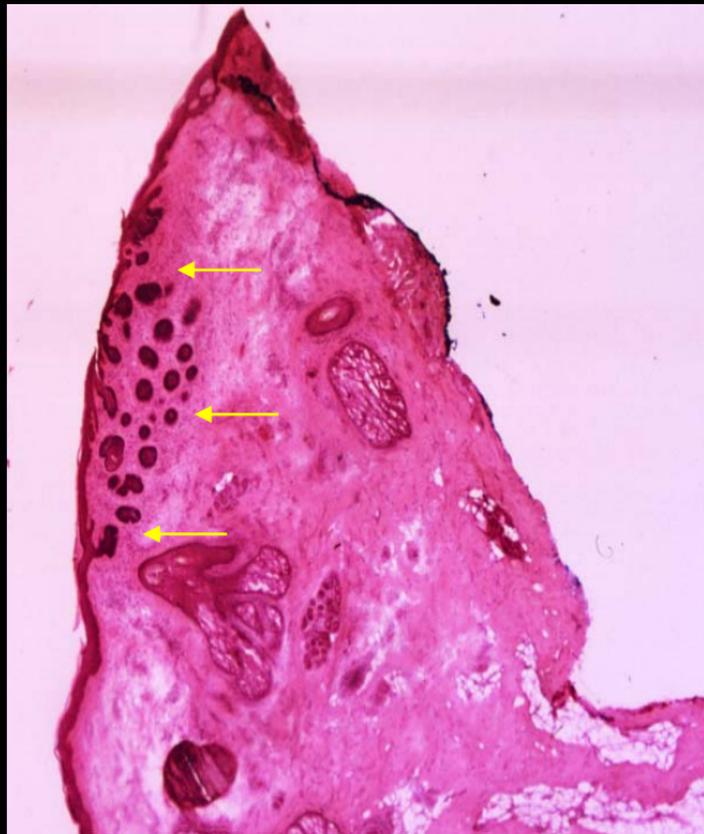
Cross-polarized confocal (0.3 NA)



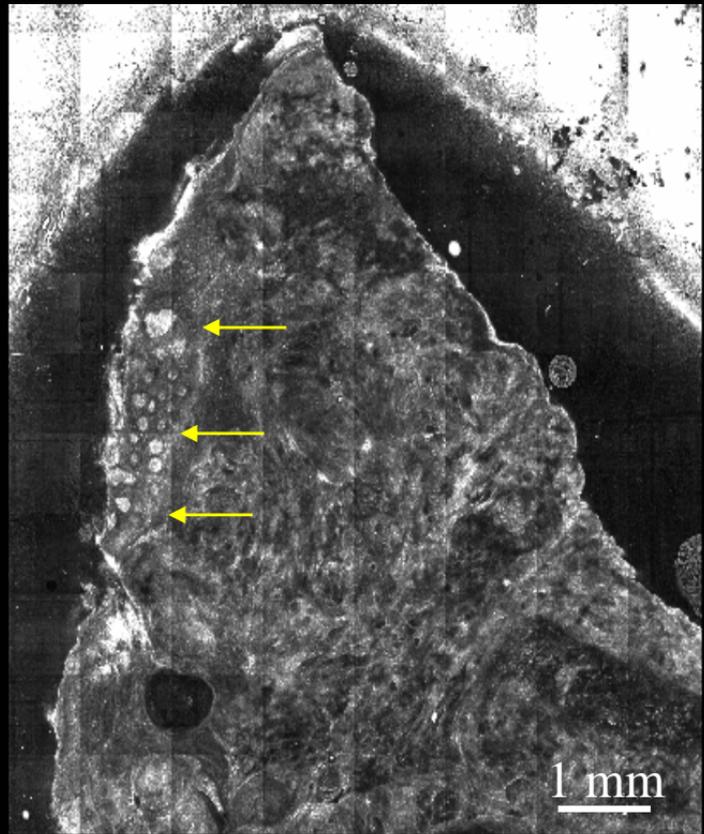
Histology

4X (field of view ~ 5 mm)

Mosaic of confocal images to examine large excisions



Histology



Confocal mosaic

Nodular BCC

Specific study aims

Funding from NIBIB/NIH

1 R01 EB002715-01

Ex vivo study

Develop acetowhitening and crossed polarization methods on excised specimens from Mohs surgery

Intra-operative study

Develop articulated confocal microscope and image BCC on patients during Mohs surgery