



UNIVERSITY OF LEEDS

Single-cell Surgery

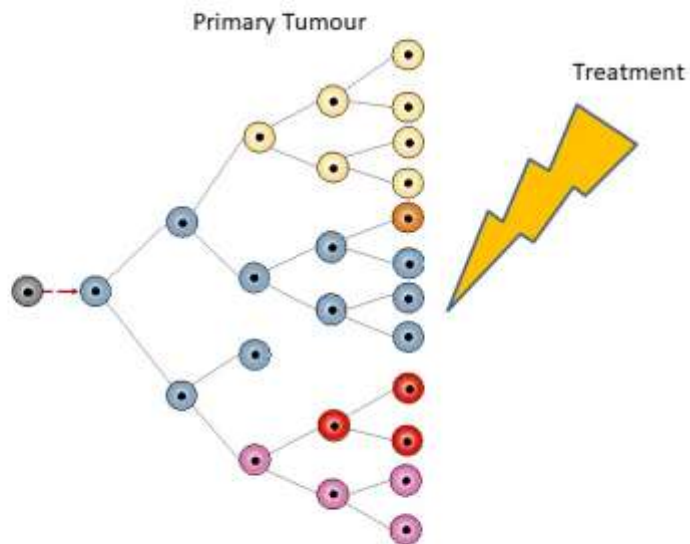
Paolo Actis
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@paoloactis

2



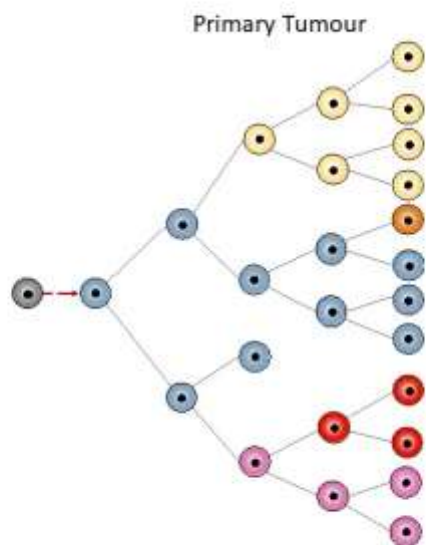
The face of tomorrow

Cancer Evolution during treatment (GBM)



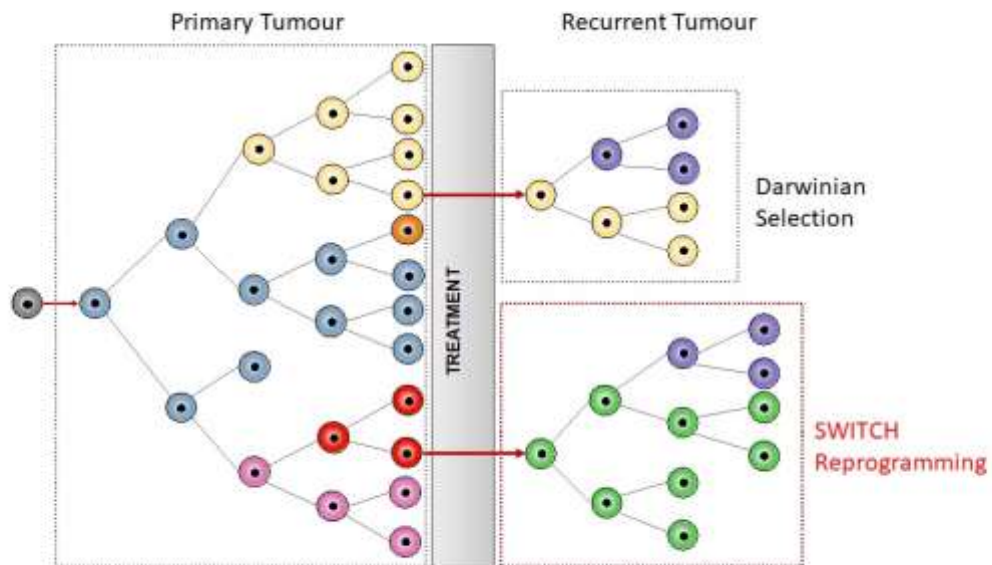
4

Cancer Evolution during treatment (GBM)



3

Cancer Evolution during treatment (GBM)



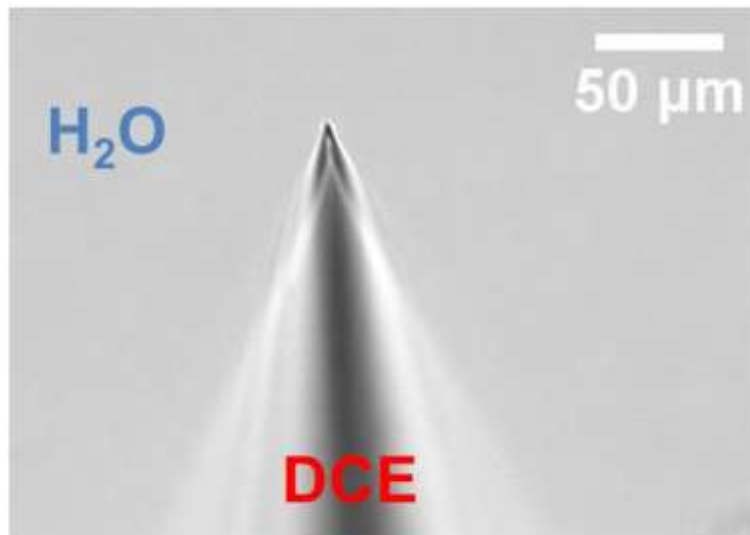
5

1. Single-Cell Nanobiopsy

Extract a tiny amount of a cell cytoplasm without killing it

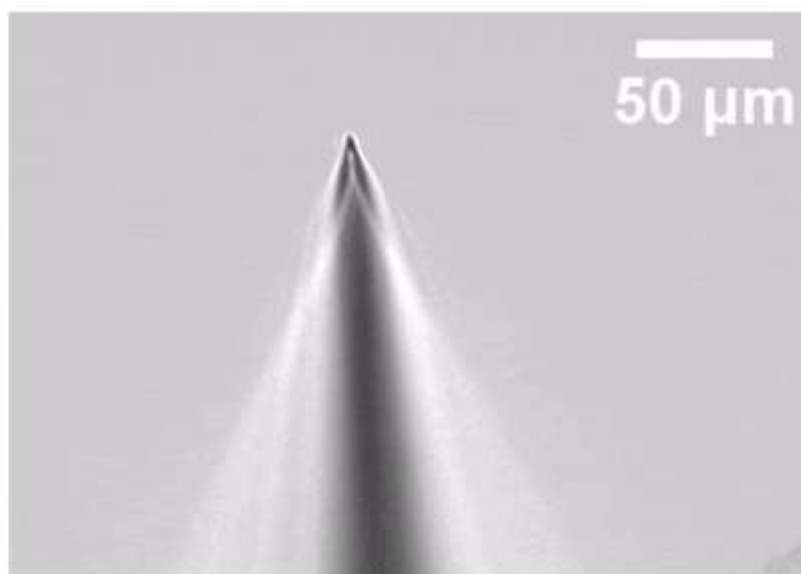
6

Electrowetting in a nanopipette

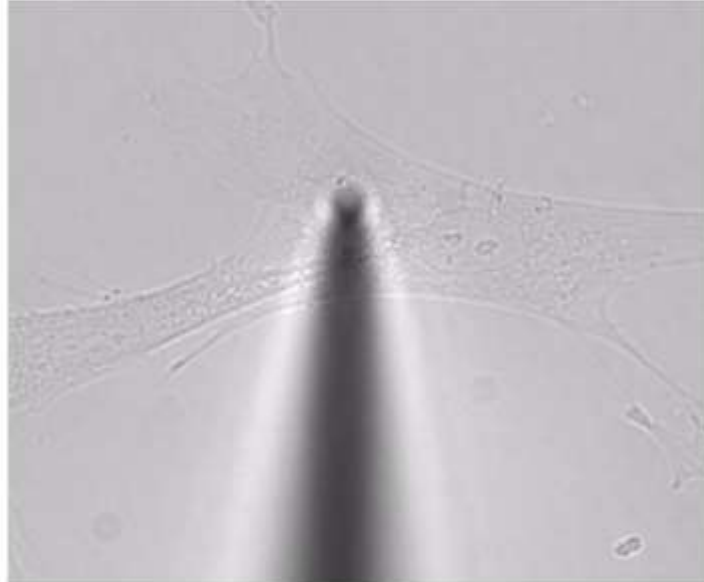


Laforge et al, PNAS, 2007
Girault et al, 1989 7

Electrowetting in a nanopipette

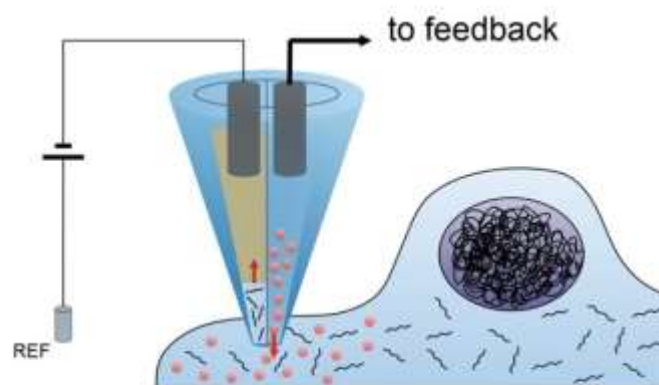


Single-Cell Nanobiopsy

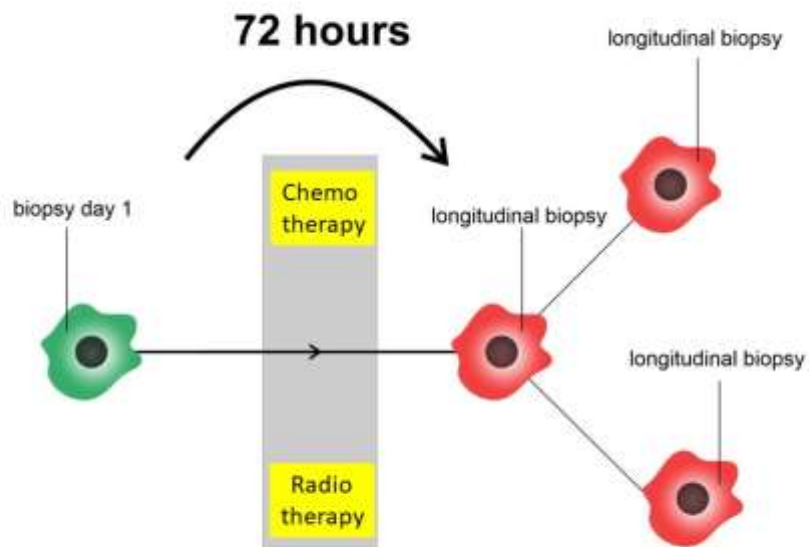


Actis et al, ACS Nano , 2013 9

Nanobiopsy and Nanoinjection

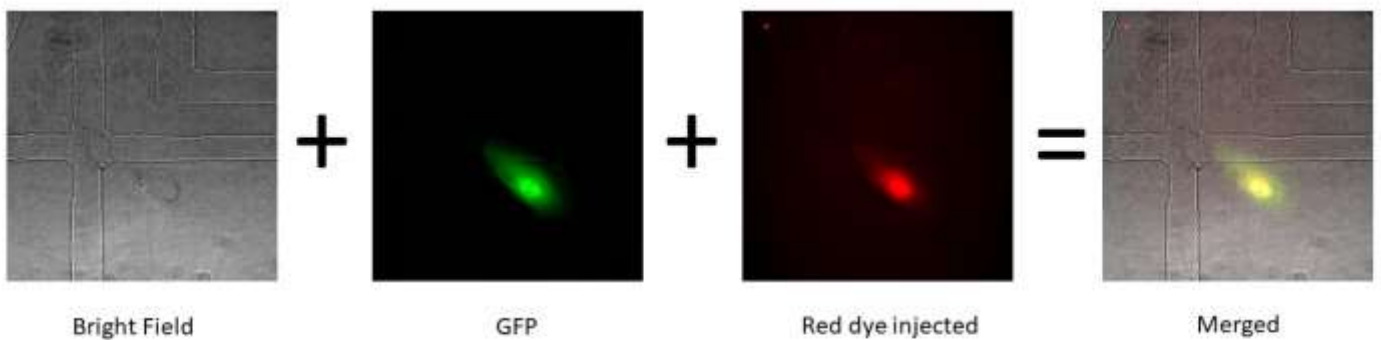


Longitudinal Sampling



11

Nanobiopsy and Nanoinjection



12

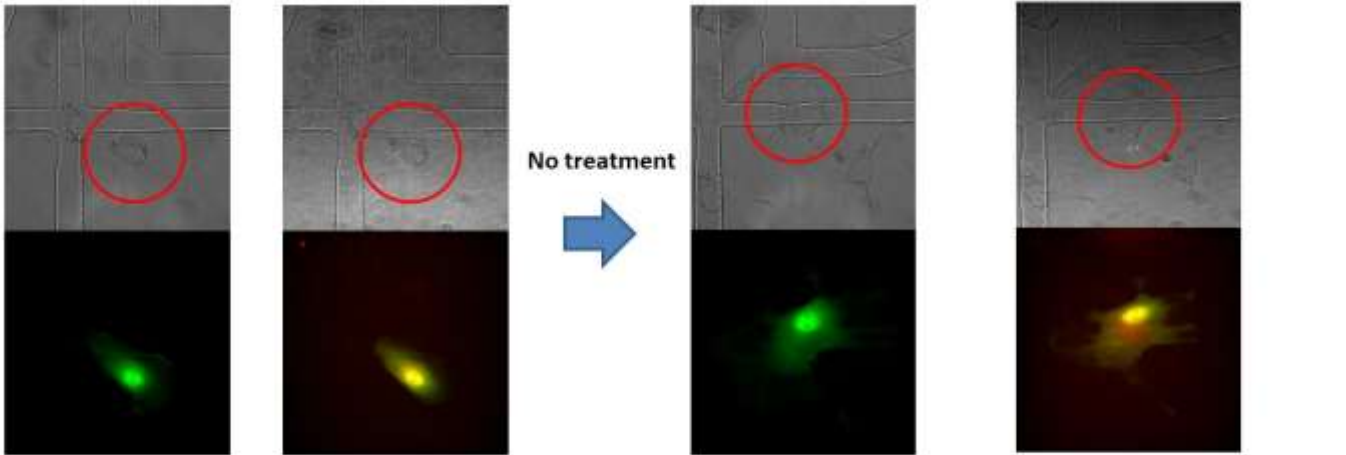
Nanobiopsy and Nanoinjection

PRE-biopsy/inj DAY 1

POST-biopsy/inj DAY 1

PRE-biopsy/inj LONGITUDINAL

POST-biopsy/inj LONGITUDINAL



13

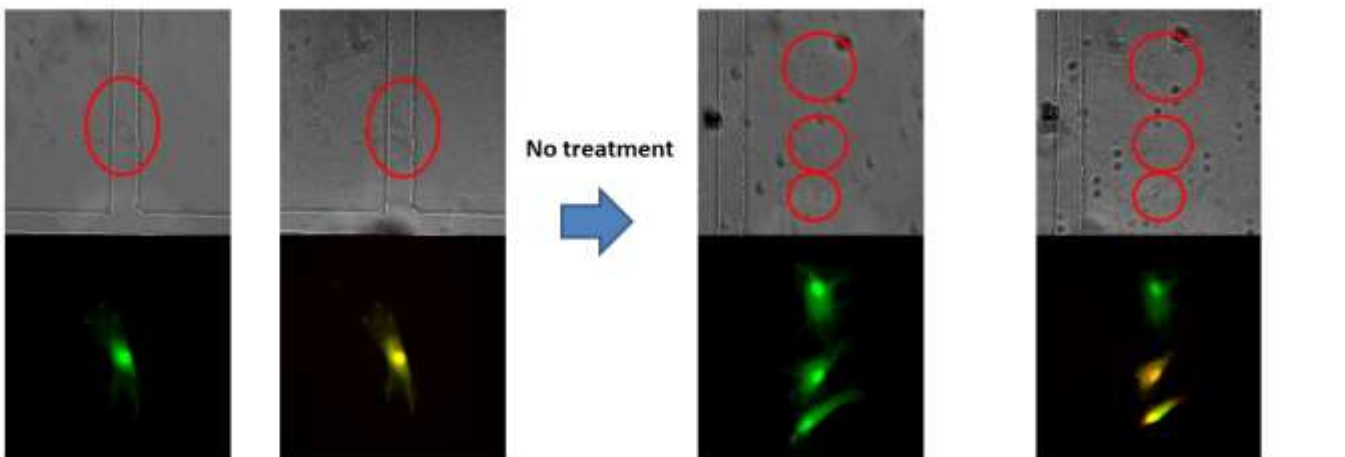
Nanobiopsy and Nanoinjection

PRE-biopsy/inj DAY 1

POST-biopsy/inj DAY 1

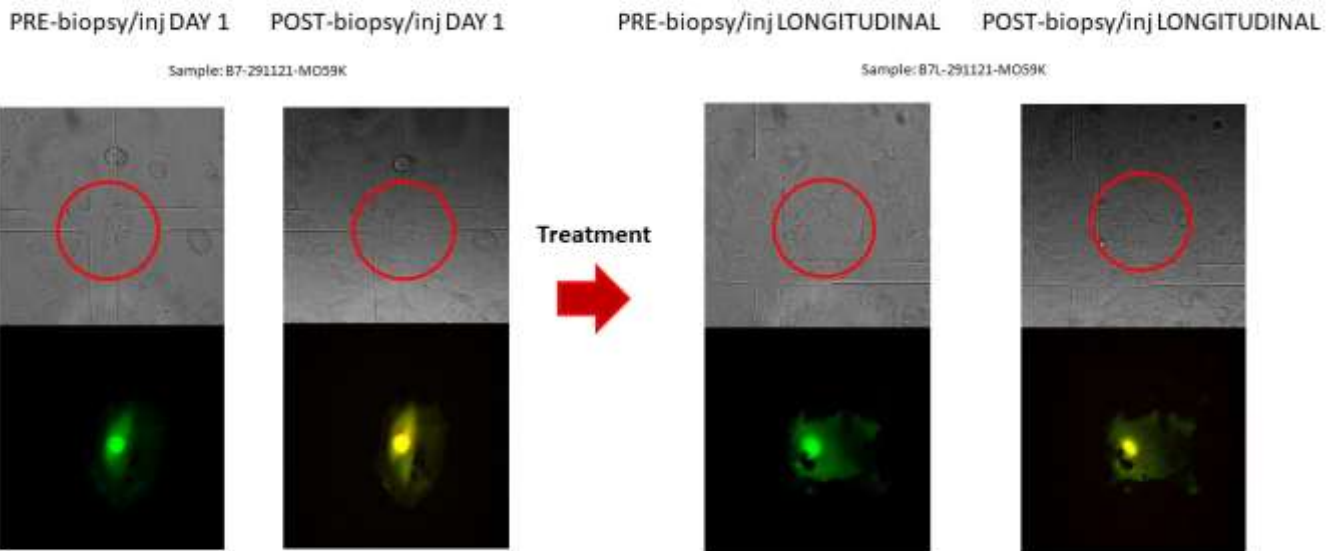
PRE-biopsy/inj LONGITUDINAL

POST-biopsy/inj LONGITUDINAL



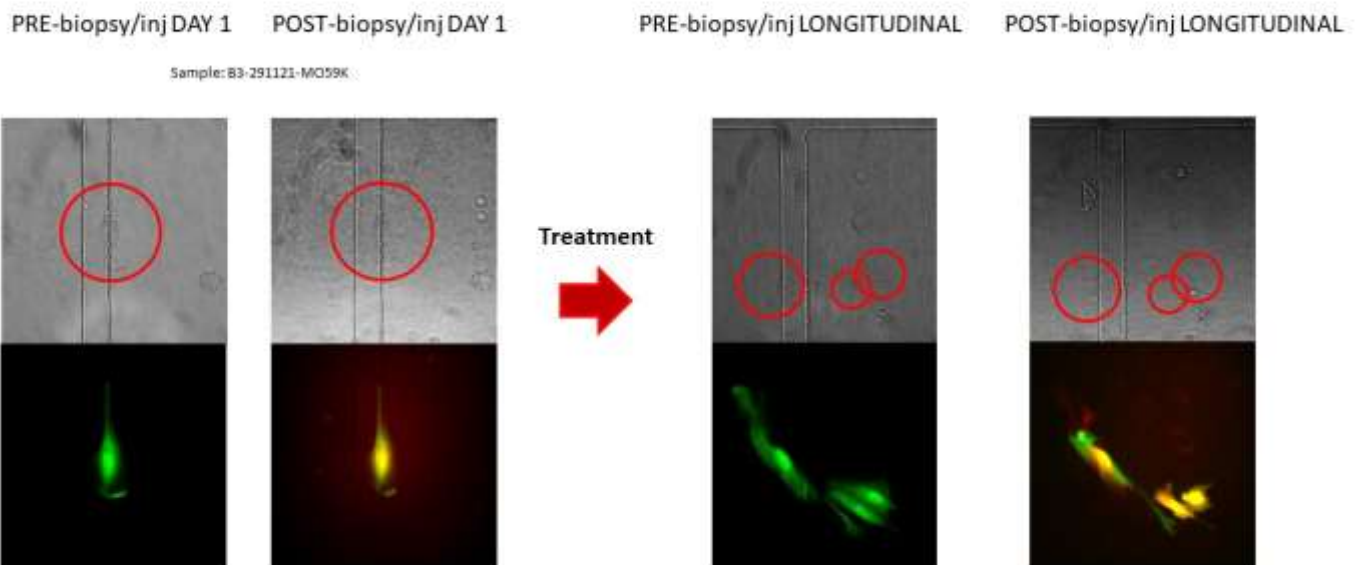
14

Nanobiopsy and Nanoinjection



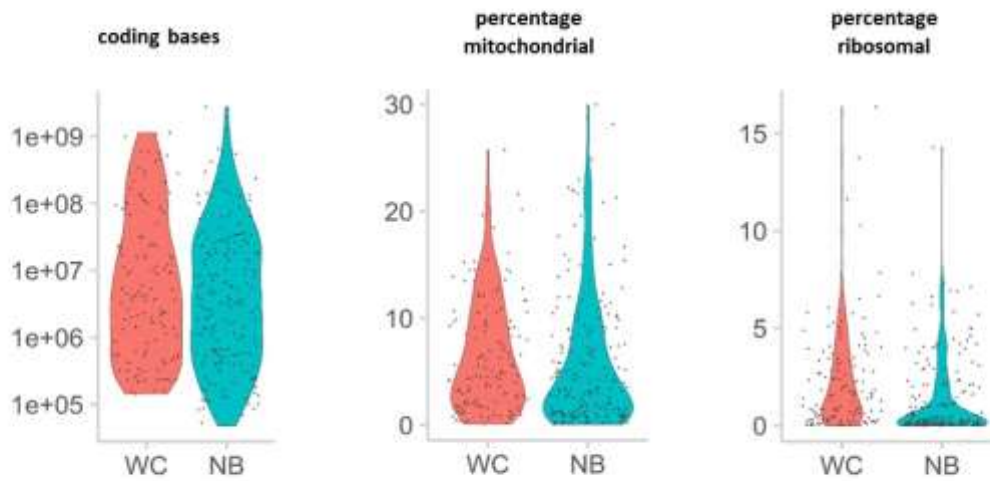
15

Nanobiopsy and Nanoinjection



16

RNA-seq results



17

Summary

Develop a platform for single cell injection and nanobiopsy

Understand cancer evolution during treatment
(GBM as proof of concept)

18

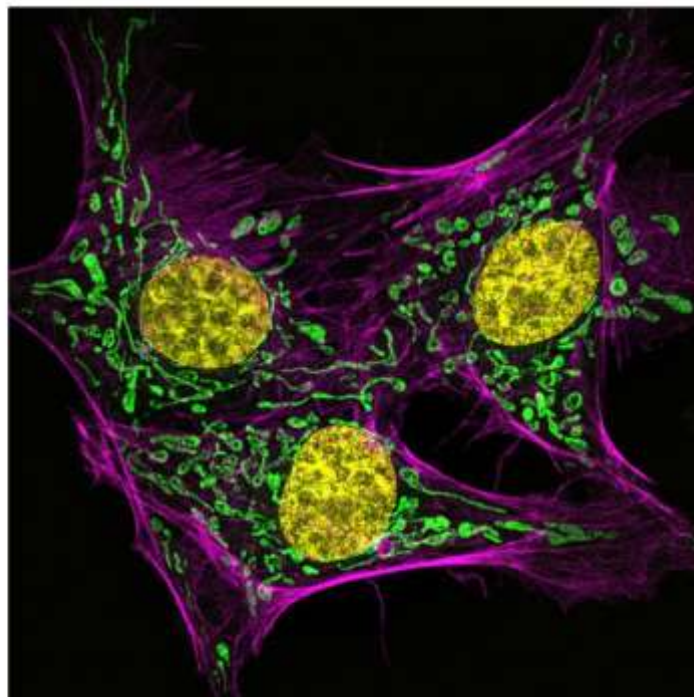
2. “Cookie Cutter”

Localized dissection from human tissues

(study mitochondrial heterogeneity in disease)

Collaboration with Newcastle University

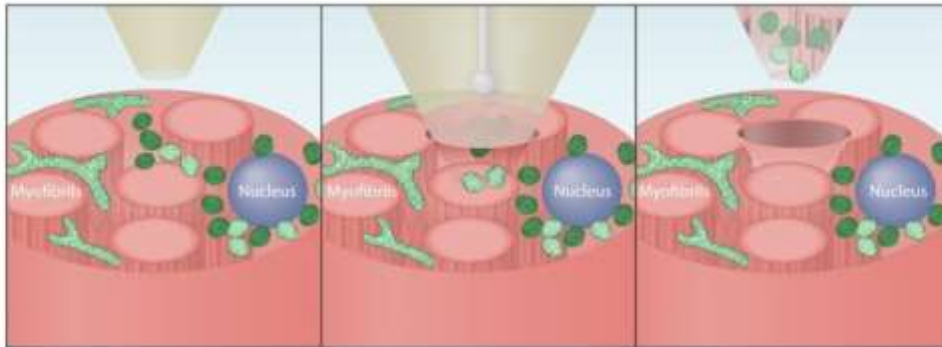
19



Nikon , 2014 20

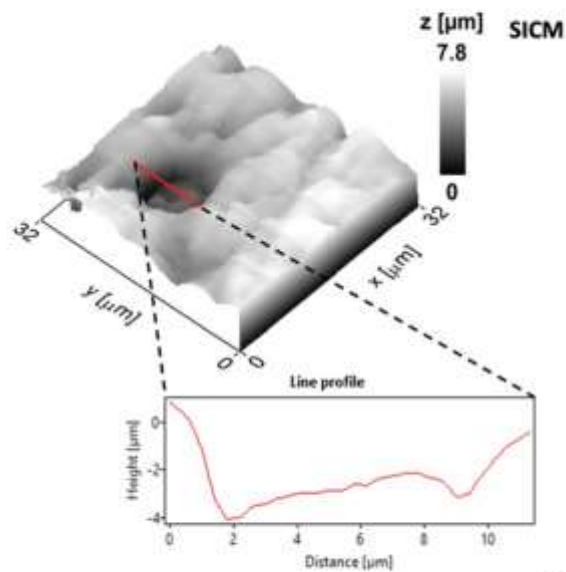
Our solution

Micropipette-based cookie cutter



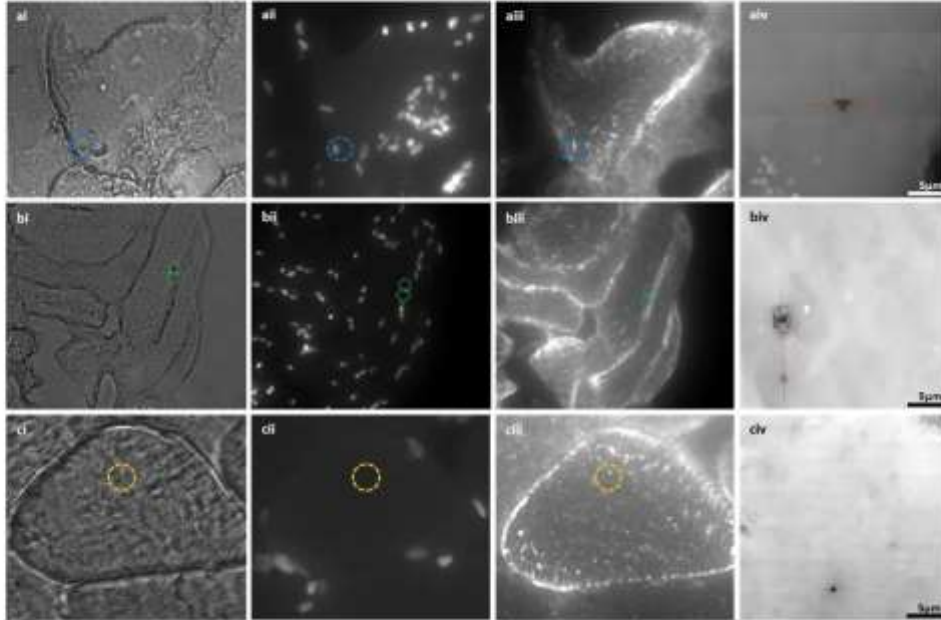
Bury et al, Anal Bioanal Chem, 2022 21

SICM imaging of the sampled region



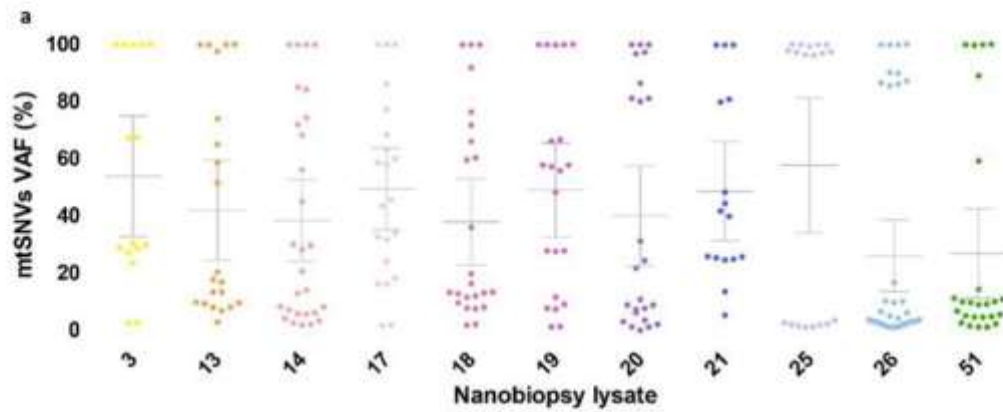
Bury et al, Anal Bioanal Chem, 2022 22

“Cookie Cutter”



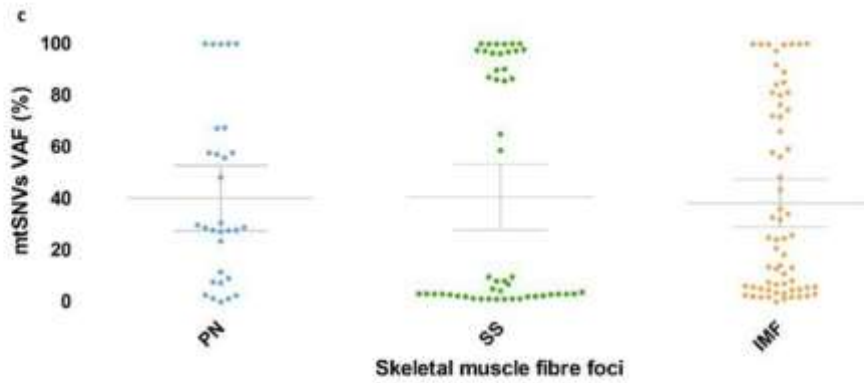
23

DNA Sequencing



24

DNA Sequencing



25

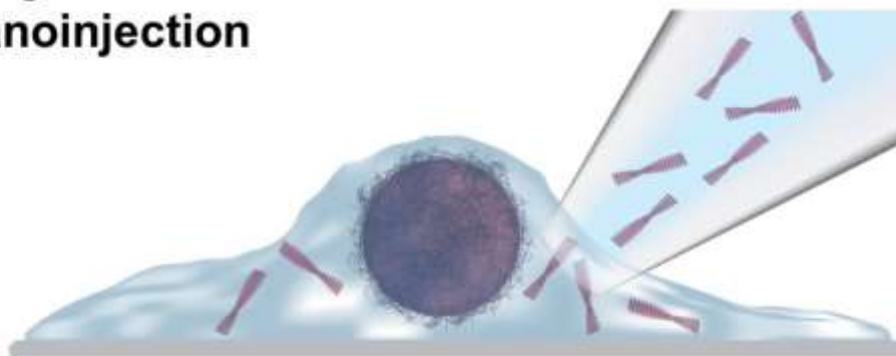
Summary

Develop a platform for mitochondrial sampling from human tissues

Geography of mitochondrial mutations in diseased tissue

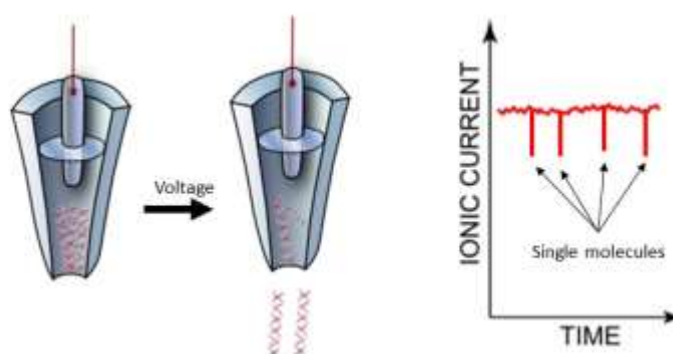
26

3. Single-molecule Nanoinjection



27

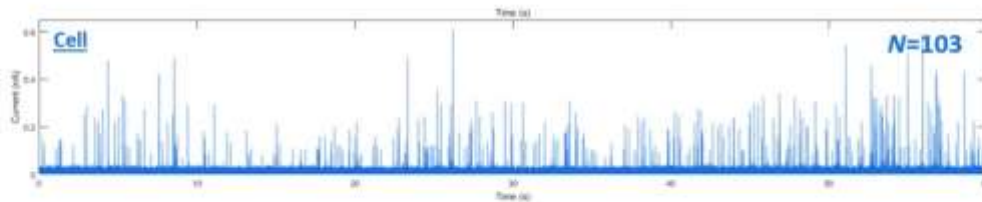
Nanopipette as single molecule sensors



Ivanov et al, ACS Nano, 2015

28

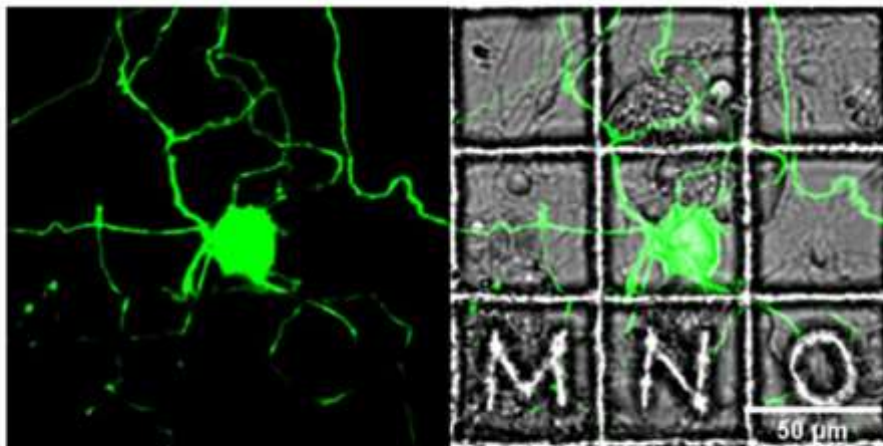
Nanoinjection



One peak, one molecule

29

GFP plasmid nanoinjection (DRG neuron)



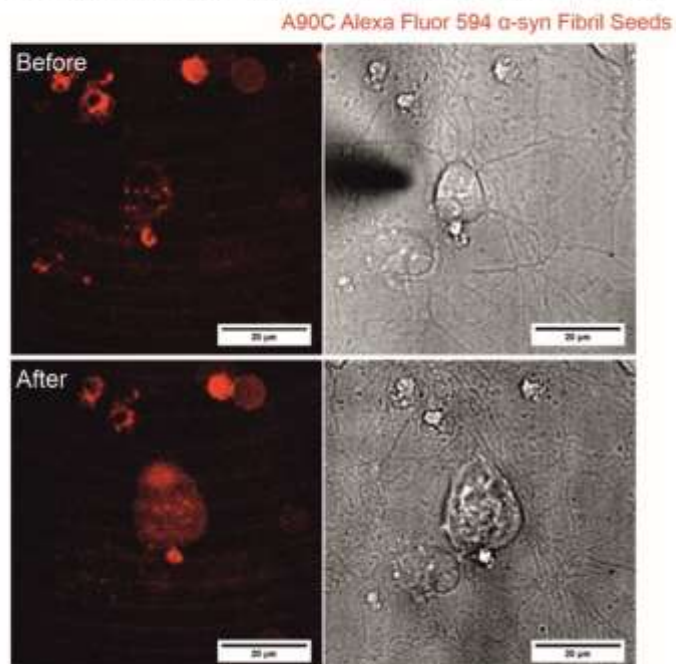
30

GFP plasmid nanoinjection



31

Protein Aggregate nanoinjection



32

Acknowledgments

1. Nanobiopsy

Fabio Marcuccio, Dr Chalmers Chau, Dr Georgette Tanner, Dr Martina Finetti, Dr Lucy Stead

2. Cookie Cutter

Alex Bury, Fabio Marcuccio, Dr Gavin Hudson, Dr Amy Vincent, Dr Angela Pyle, Prof Sir Doug Turnbull FRS

3. Nanoinjection

Dr Chalmers Chau, Dr Eric Hewitt, Prof Sheena Radford OBE FRS

Funding



33



**Thank you
very much!**

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