

Real-time indication of tissue characteristics in frameless brain tumor biopsies

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Background

Brain tumor biopsies are performed to confirm diagnosis and tailor treatment. Adverse events include

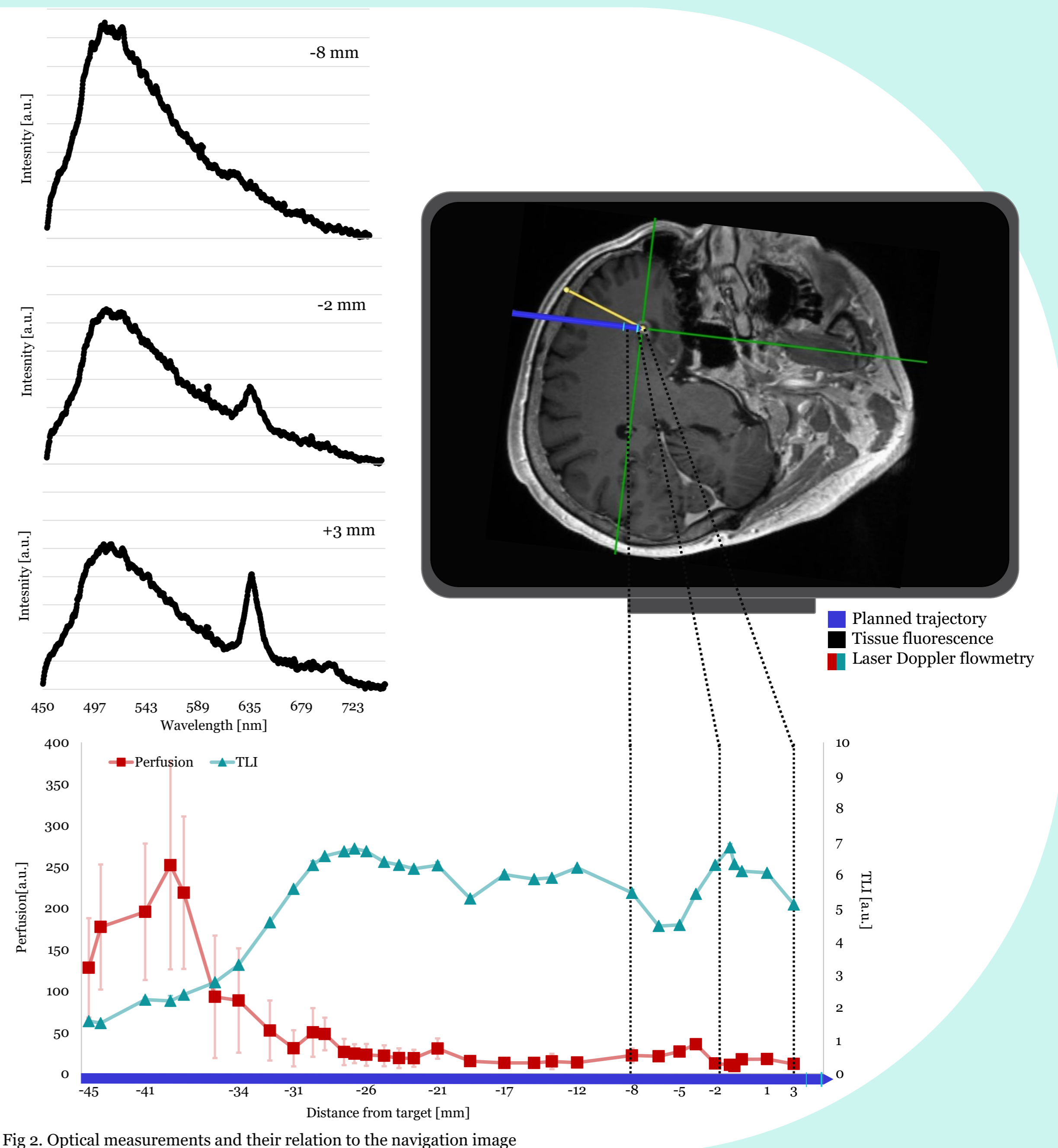
- inconclusive biopsy results [1]
- hemorrhage [1,2]

The standard procedure is based solely on preoperative magnetic resonance images both for trajectory planning and guidance.

Aim

The aim of this study was to

- build and adapt an optical probe system to the frameless biopsy procedure
- find and automate the calculation of a transform to combine the optical data with the image information
- evaluate the methodology in clinical cases



Methods

Optical system

A dual optics system [3] was built to allow forward-looking measurements of tissue

- fluorescence (5-aminolevulinic induced- [4,5] and auto-)
- perfusion (i.e., microcirculation)
- light intensity (i.e., gray-whiteness [6], TLI)

An optical probe was adapted to fit inside the outer cannula of a frameless biopsy needle, which in turn was modified with an aperture at the tip.

During surgery

Optical measurements were displayed in real-time along the planned trajectories. As fluorescence peaks were registered at or in the vicinity of the precalculated target, the probe was replaced by the inner cannula of the biopsy needle.

Tissue samples were sent for neuropathological analysis according to standard protocol.

Data analysis

Postoperative data analysis included image correction, registration, and signal normalization. Mean, standard deviation, and affine transforms between modality spaces were calculated.

Results

Out of nine clinical cases, fluorescence indicating tumor was found in eight patients. A slight increase in perfusion was detected at four sites along the trajectories.

Pathologists confirmed all samples to be tumor tissue after 30-60 minutes of taking the biopsy.

Post-operative imaging did not indicate any hemorrhage or blood vessel lesions along the trajectory and confirmed biopsy location.

Conclusions

The technique shows promising results for identifying tissue characteristics during frameless biopsy procedures.

References

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