

Feasibility study on the monitoring of lesions in ciliary bodies using Acoustic Radiation Force

Victor Delattre¹, Ali Zorgani, Stefan Catheline¹, Florent Aptel², Cyril Lafon¹

¹Inserm Labtau U1032, Lyon, France, ²Inserm U1042, Grenoble, France

Background, Motivation and Objective

Eyetechcare eyeOP1 probe is a medical device used in the treatment of glaucoma. It aims at reducing intra ocular pressure by coagulating the ciliary bodies using High Intensity Focused Ultrasound (HIFU). Although more than 1000 patients have already been treated, the success rate is of 60-70%. In order to achieve better results, it is necessary to monitor lesion development to adapt the treatment accordingly. We investigated the use of the therapy transducers of the probe as generators of acoustic radiation force (ARF) and as imaging transducers.

Statement of Contribution/Methods

We first carried out ex vivo experiments using dead rabbit eyes to tune the experimental protocol. We then carried the experiment on two sedated rabbits to evaluate the relevance of this technique in vivo. A first set of ARF pushes (referred as trials) was sent triggering the listening of another transducer of the probe. A speckle tracking algorithm was used to compute the displacement of the tissues. Averaging across trials we obtained a mean displacement. For the control rabbit we repeated the sequence right away and computed the correlation coefficient between the two mean displacements. For the second rabbit we proceeded the same way but with a HIFU shot performed by the ARF transducer between the two sets of trials. We obtained 6 acquisitions with the control rabbit and 9 with the other one.

Histological cuts of the eye of the second rabbit were made to assess the damage in the ciliary bodies. This work was funded by the FUS fondation.

Results/Discussion

As shown in figure 1, the displacement did not vary between the two sets of trials with the control rabbit (average correlation coefficient 0.88) whereas it was significantly different with the rabbit undergoing HIFU treatment (average correlation coefficient 0.54) when the presence of lesions was confirmed by the histological cuts.

These preliminary experiments show that we can use resonating therapy transducers as imaging transducers and suggest that this technique is a good candidate to monitor the treatment as it exhibits an obvious difference in the tissue mechanical response to ARF when a lesion occurred in the ciliary bodies. Further investigation is needed to obtain statistical weight and to be able assess if a link can be found between the severity or localization of the lesion and the drop of correlation of displacement before and after the treatment.

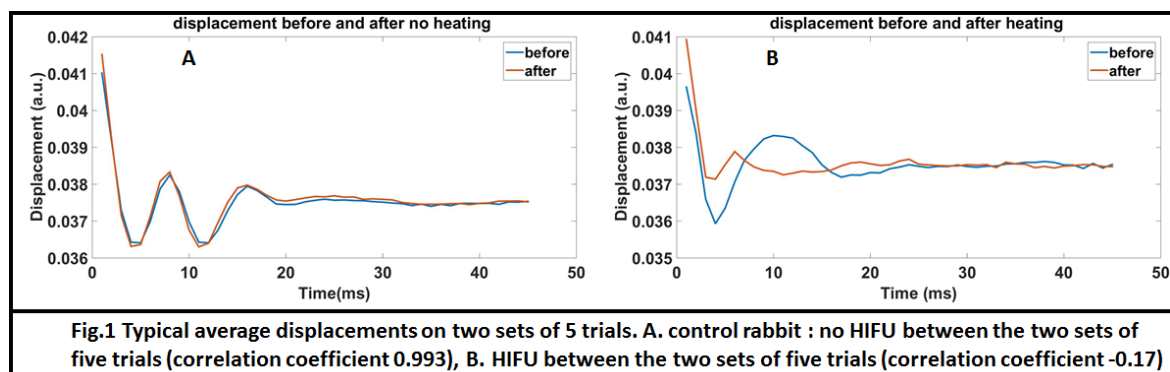


Fig.1 Typical average displacements on two sets of 5 trials. A. control rabbit : no HIFU between the two sets of five trials (correlation coefficient 0.993), B. HIFU between the two sets of five trials (correlation coefficient -0.17)