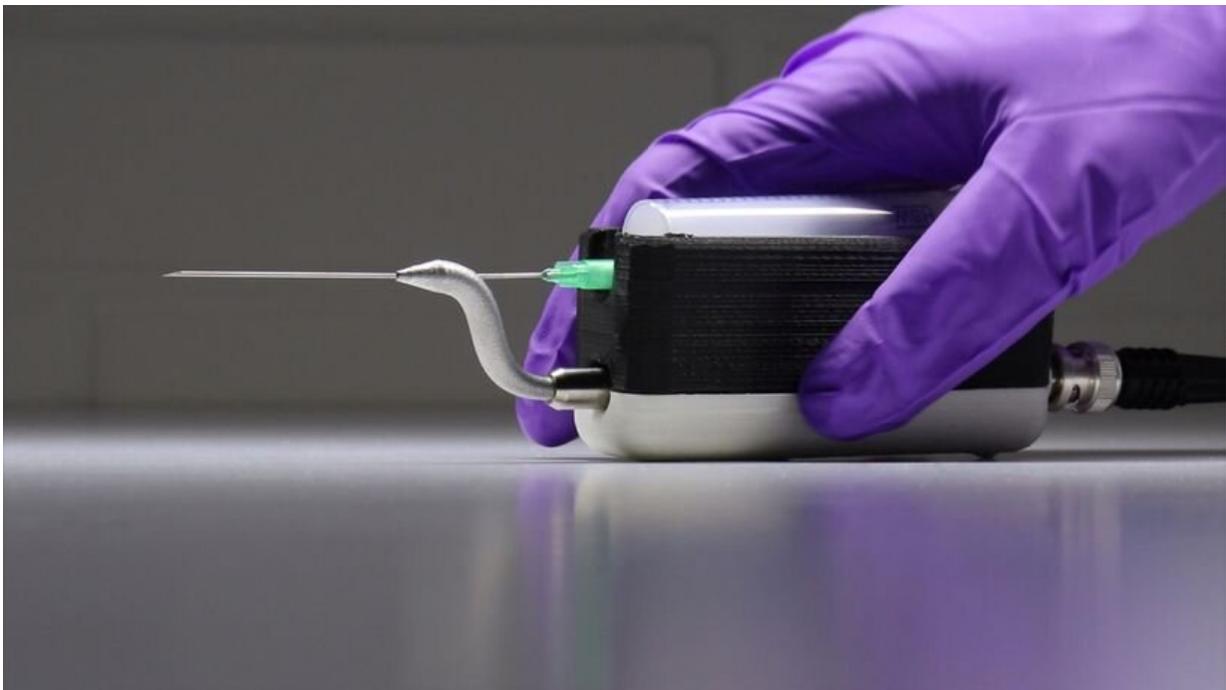


How nonlinear ultrasound can be used to create vibrations in an ordinary medical needle

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Credit: Aalto University

The technology of medical needles has not changed dramatically in 150 years. In his doctoral research, Emanuele Perra explored if nonlinear ultrasound can be used to overcome the limitations of currently used medical needles, such as the pain experienced by patients, inaccuracy

and variable quality of needle samples. The study follows on from [previous research into the use of ultrasound](#).

"In this study, we used needles to generate transverse-like motions at 30 kHz. This allows the [acoustic energy](#) to be amplified towards the [needle tip](#), exactly where the effect is needed. This localized ultrasound energy can be used in a variety of applications, such as improving the quality of needle samples," says Professor Heikki Nieminen, who is leading the project.

Using computer models and experimental studies, the researchers were able to show that oscillations of the needle caused a number of non-linear acoustic phenomena. These include [cavitation](#), the sudden expansion and collapse of air bubbles; the formation of acoustically driven fluid flows; acoustic radiation force, the force exerted by an ultrasonic wave on an object; and the formation of micro-droplets.

"The investigated approach has the potential to give conventional medical needles new enhanced functions in [medical applications](#) not only in tissue biopsy but also in drug or gene delivery, cell stimulation, and minimally invasive surgical procedures," says Nieminen.

Provided by Aalto University

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