How sound waves could help regrow bones

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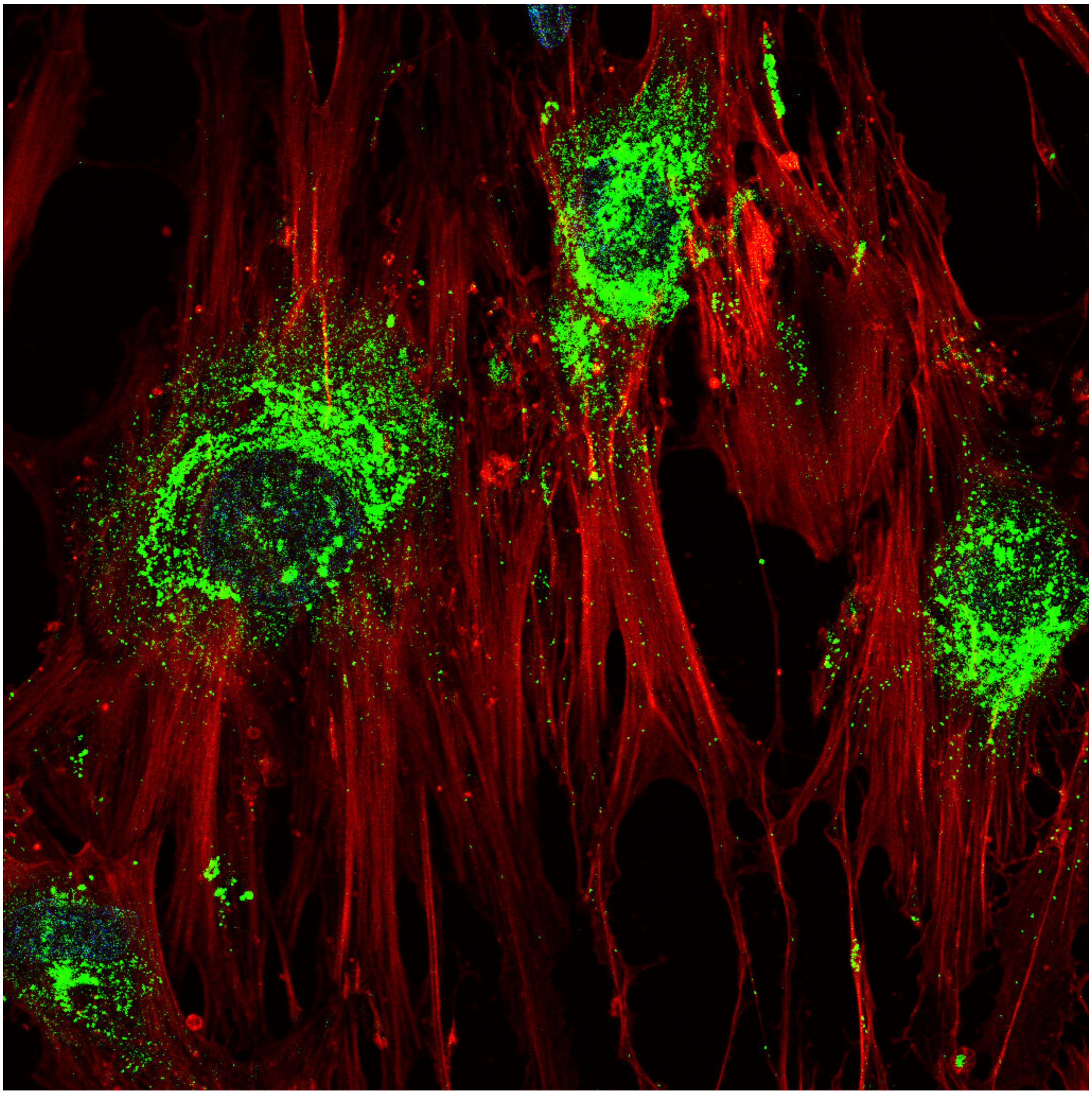


Magnified image showing adult stem cells in the process of turning into bone cells after treatment with high-frequency sound waves. Green colouring shows the presence of collagen, which the cells produce as they become bone cells. Magnification: 60X. Credit: RMIT University

Researchers have used sound waves to turn stem cells into bone cells, in a tissue engineering advance that could one day help patients regrow bone lost to cancer or degenerative disease.

The innovative stem cell treatment from researchers at RMIT University offers a smart way forward for overcoming some of the field's biggest challenges, through the precision power of high-frequency sound waves.

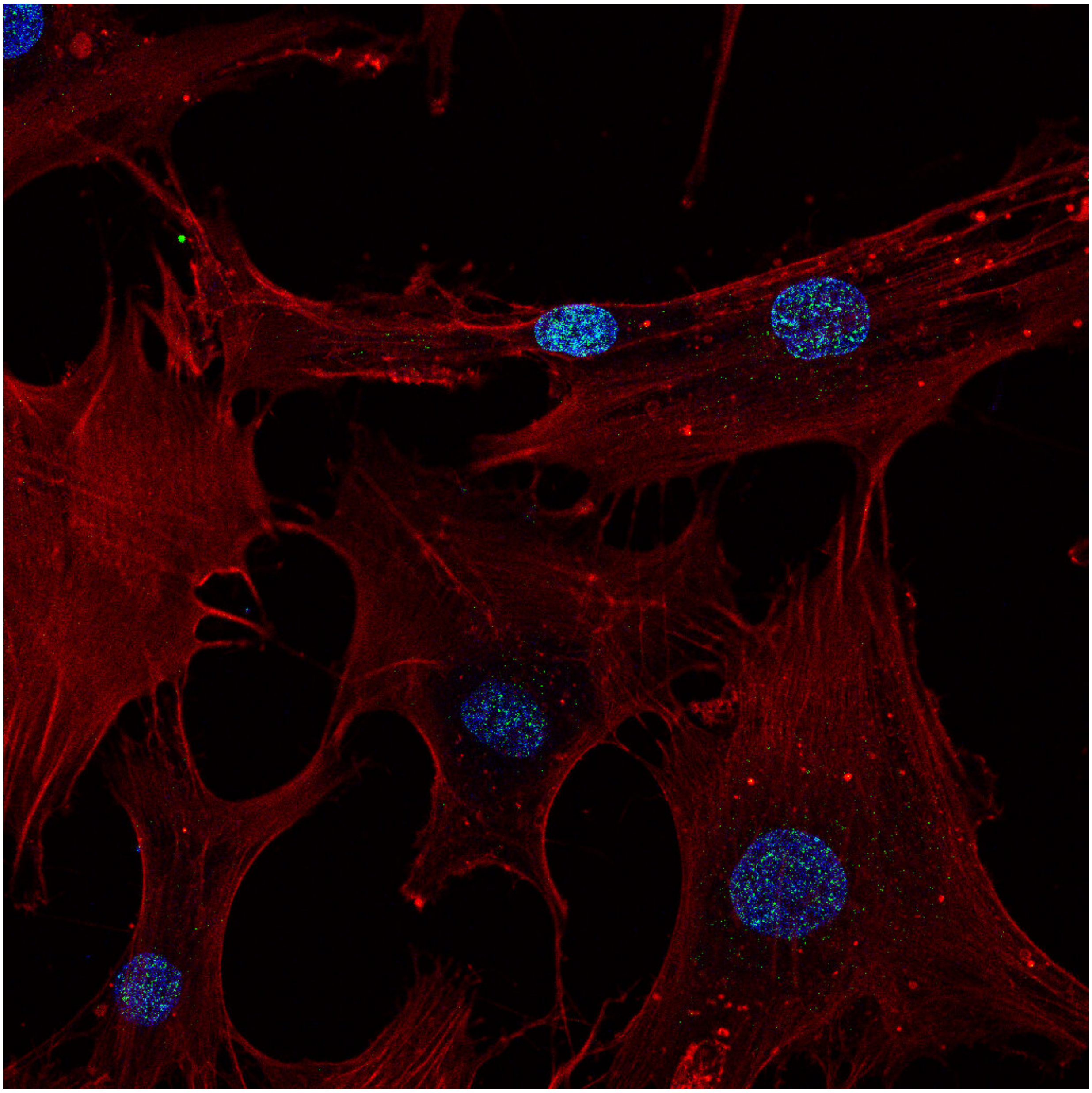
Tissue engineering is an emerging field that aims to rebuild bone and muscle by harnessing the human body's natural ability to heal itself.

A key challenge in regrowing bone is the need for large amounts of bone cells that will thrive and flourish once implanted in the target area.

To date, experimental processes to change adult stem cells into bone cells have used complicated and expensive equipment and have struggled with mass production, making widespread clinical application unrealistic.

Additionally, the few clinical trials attempting to regrow bone have largely used stem cells extracted from a patient's bone marrow—a highly painful procedure.

In a new study published in the journal *Small*, the RMIT research team showed stem cells treated with high-frequency sound waves turned into bone cells quickly and efficiently.



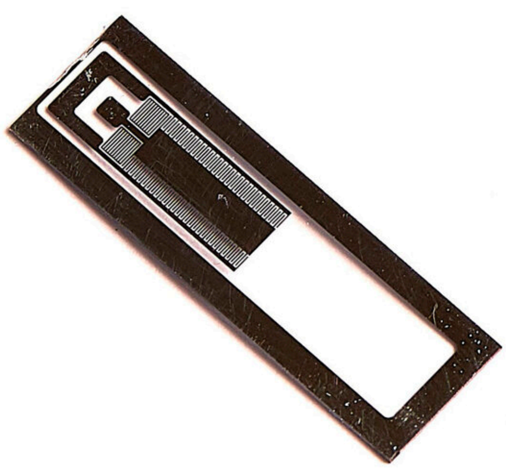
Magnified image showing adult stem cells in the process of turning into bone cells after treatment with high-frequency sound waves. Purple spots indicate the presence of a “bone marker” known as RUNX2. Magnification: 60X. Credit: RMIT University

Importantly, the treatment was effective on multiple types of cells including fat-derived stem cells, which are far less painful to extract from a patient.

Fast and simple

Co-lead researcher Dr. Amy Gelmi said the new approach was faster and simpler than other methods.

"The sound waves cut the treatment time usually required to get stem cells to begin to turn into bone cells by several days," said Gelmi, a Vice-Chancellor's Research Fellow at RMIT.



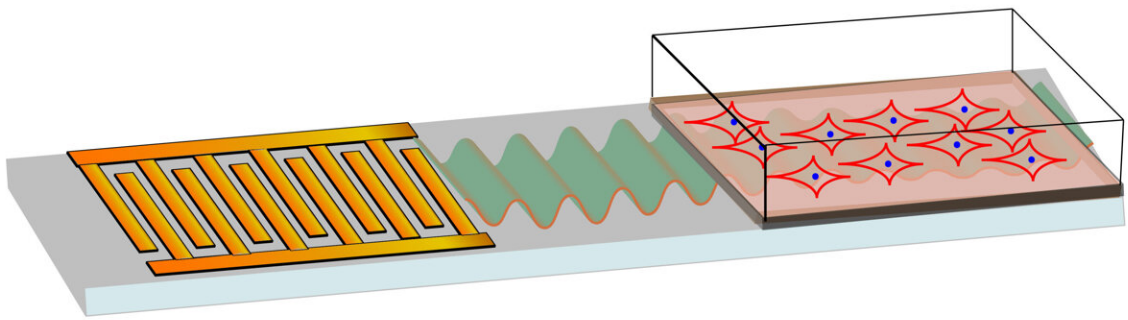
The high-frequency sound waves for the stem cell treatment are generated on this microchip, low-cost and easy-to-scale technology developed by RMIT University. Credit: RMIT University

"This method also doesn't require any special 'bone-inducing' drugs and it's very easy to apply to the stem cells.

"Our study found this new approach has strong potential to be used for treating the stem cells, before we either coat them onto an implant or inject them directly into the body for tissue engineering."

The high-frequency sound waves used in the stem cell treatment were generated on a low-cost microchip device developed by RMIT.

Co-lead researcher Distinguished Professor Leslie Yeo and his team have spent over a decade researching the interaction of sound waves at frequencies above 10 MHz with different materials.



A graphic illustration of the innovative stem cell treatment. The microchip on the left generates high-frequency sound waves (green) to precisely manipulate the stem cells, which are placed in silicon oil on a glass-bottomed culture plate. Credit: RMIT University

The sound wave-generating device they developed can be used to precisely manipulate cells, fluids or materials.

"We can use the sound waves to apply just the right amount of pressure in the right places to the stem cells, to trigger the change process," Yeo said.

"Our device is cheap and simple to use, so could easily be upscaled for treating large numbers of cells simultaneously—vital for effective tissue engineering."

The next stage in the research is investigating methods to upscale the platform, working towards the development of practical bioreactors to drive efficient stem cell differentiation.

"Short-Duration High Frequency MegaHertz-Order Nanomechanostimulation Drives Early and Persistent Osteogenic Differentiation in Mesenchymal Stem Cells" is published in *Small*.

More information: Lizebona August Ambattu et al, Short-Duration High Frequency MegaHertz-Order Nanomechanostimulation Drives Early and Persistent Osteogenic Differentiation in Mesenchymal Stem Cells, *Small* (2022). DOI: 10.1002/smll.202106823

Provided by RMIT University