Research summary

Growing new bone cells with eggshell scaffolds

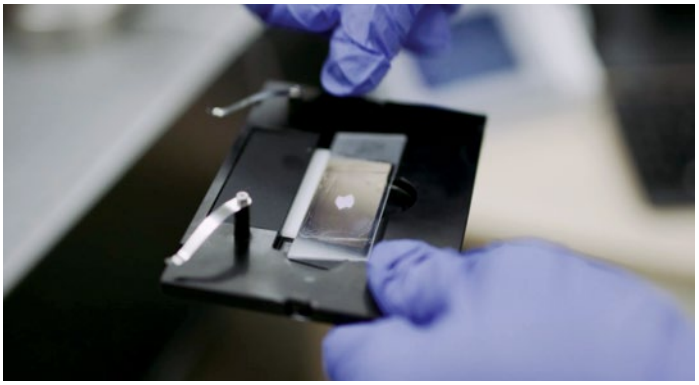
About the study

Finding new ways to repair damaged bone is an essential field of research in human health. In fact, after blood, bone is the second most frequently transplanted tissue worldwide. Currently, the most common treatment for bone defects is the autograft procedure, in which a patient's healthy bone tissue is grafted onto the damaged area. Although this procedure is effective, it is painful for the patient and expensive to perform, requiring long surgical procedures.

While eggshells might seem to be an unconventional solution to bone grafting, researchers at the University of Ottawa recognized the potential for eggshells to be used as a regenerative material to grow new bone tissue, and developed a study to further explore this possibility.

Methods

The study involved testing two types of eggshell particles for their suitability as bone regenerative material. The first material was regular eggshell particles and the second was a nanotextured material created by treating eggshell particles with phosphoric acid. The particles were suspended in porous 3D scaffolds, and a third, blank scaffold without particles was also created to use as a control.



To test these particles for bone regeneration, human mesenchymal stem cells, which can differentiate into distinct types of cells, were injected into each scaffold and cultured for 21 days. Every seven days, the scaffolds were evaluated for number of living cells, the shape and size (or "morphology") of the cells, and the levels of alkaline phosphatase, an enzyme secreted when stem cells differentiate into new bone cells. At day 21, the cells were further examined to evaluate morphology.

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Findings

The scaffolds made using regular and nanotextured eggshell particles both had higher porosity (allowing nutrients to move and promote cell growth), were stronger and had an increased resistance to degradation compared to the blank scaffold. These properties suggest both scaffolds made with eggshells are more suitable for bone regeneration.

Furthermore, when measured after 21 days, both eggshell scaffolds were able to support the survival of the stem cells, while nearly all of the cells in the blank scaffold had died or disappeared.

The scaffold made with nanotextured eggshells displayed significantly higher alkaline phosphatase activity after 14 and 21 days, while the regular eggshell scaffold showed higher levels after 21 days. This suggests osteogenesis, or the creation of new bone cells, was occurring in both of these scaffolds, unlike the blank scaffold.

The cells placed in both eggshell scaffolds also demonstrated changes in morphology, from round to a more rectangular, stretched-out shape, indicating the mesenchymal stem cells were becoming bone cells or osteoblasts. The small number of cells in the blank scaffold did not change their morphology over the 21 days.

Conclusions

This study clearly showed that the scaffolds made with normal and nanotextured eggshells have many of the properties necessary for bone regeneration. This suitability was confirmed by demonstrating that both scaffolds supported mesenchymal stem cells over 21 days and promoted their differentiation into bone-like cells. These results suggest that both normal and nanotextured eggshell particles placed in a scaffold demonstrate a capacity for growth of new bone cells to repair damaged bones.

This potential to grow new bone cells to repair damaged or missing bone tissue presents an exciting opportunity to develop this research further. As the researchers test these conclusions on a broader scale, the possibility of improving human health remains high.

About the researchers

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