Glass helps bone GROWTH

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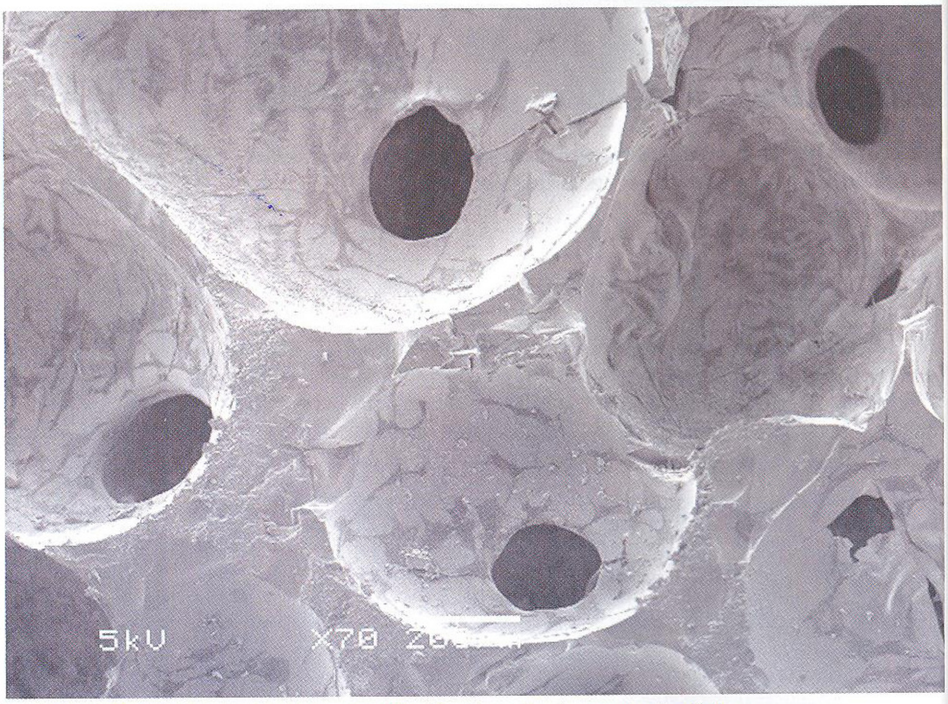
The porous glass, originally developed at Imperial College is capable of acting as an active template for new bone growth, dissolving in the body without leaving any trace of itself or any toxic chemicals. As it dissolves it releases calcium and other elements such as silicon into the adjacent body fluids, stimulating bone growth.

The glass activates genes present in human bone cells which encode proteins controlling the bone cell cycle and the differentiation of the cell to form bone matrix and rapid mineralisation of bone nodules. It is the release of soluble silica and calcium ions in specific concentrations that activate the genes. Gene activation occurs only when the timing sequence of the cell cycle is matched by that of the glass surface reactions and controlled release of the ions.



A microscopic image of bone cells grown on bioactive glass after two weeks of activity

Relationship

Partners at the Universities of Kent and Warwick have been carrying out experiments at the Science and Technology Facilities Council's world leading ISIS neutron source. Resarch at ISIS is showing exactly how the calcium is held in the glass and thereby precisely how it is released into the body. Professor Bob Newport at the University of Kent explains that it was when the material was studied at ISIS that the process became clear.

"Although variants of these bioactive materials are already in clinical use, and the role of calcium in these materials was already understood as being critical in terms of both the stability of the glass and its bioactivity, no direct and quantitative study of the calcium atoms within the glass network had been undertaken." says Professor Bob Newport. "Using ISIS to study the relationship between these atoms and the host silicate glass via techniques unique to neutron diffraction has enabled us to move forward with the programme. The key outcome of our experiments has been a full understanding, at the level of atomic arrangements, of why it is that calcium is able so easily to leave the glass at the rate required to generate the desired response."

By comparing samples made with natural calcium and with a calcium isotope it was possible for the first time to isolate the complex and subtle contribution of the calcium from that of all the other atoms present.

Andrew Taylor, the Director of the ISIS neutron source commented:

"To allow people to remain active, and to contribute to society for longer, the need for new materials to replace and repair worn out and damaged tissues becomes ever more important. We're pleased that at ISIS we can continue to contribute to cutting edge research that affects all our lives."

Further research

Further research is planned at the ISIS 2nd Target Station when it opens later this year. This will investigate glass/polymer hybrids and could be instrumental in developing mechanically stronger versions of the glass that would be load bearing and available for medical use in the context of joint replacement.

Reference: Jones, J. R. Tsigkou, O., Coates, E. E., Stevens, M. M., Polak, J. M., Hench, L. L. "Extracellular matrix formation and mineralization of on a phosphate-free porous bioactive glass scaffold using primary human osteoblast (HOB) cells" Biomaterials, 2007, 28, 1653-1663.