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Vitrification of Living Cartilage Allografts and a novel system design for ‘Liquidus Tracking’

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Approximately 70,000 total knee replacements are performed in the UK every year; most last 10–15 years after which replacement may be required. Autografts and allografts can be used in surgical repair however osteochondral allografting techniques are limited by restricted availability of living donor tissue at the required time. Options for storage of living cartilage are limited by the rapid decrease in cell function over time. Standard cryopreservation techniques give poor post-thaw functional cell survival rates, often 5% or lower due to extracellular and intracellular crystallisation of ice in the chondrons during cryopreservation.

In the “liquidus tracking” (LT) approach to cryopreservation, both the temperature and the concentration of cryoprotectant (CPA) are controlled by external means such that solution composition “tracks” the liquidus (melting point) line for that system. Ice crystal formation is prevented but the tissue is not exposed to CPA concentrations exceeding those experienced by cells in suspension during conventional cryopreservation. This approach is particularly appropriate for articular cartilage as chondrocytes in situ are exquisitely susceptible to damage through extracellular crystallization of ice, unlike cell suspensions. LT can minimise the impact of CPA toxicity and has been shown to maintain cell function at 75-95%.

Several approaches are being taken for vitreous cryopreservation of whole cartilage. For clinical application, an automated vitrification technique is required to standardise treatment of tissue to meet clinical criteria. The work of Pegg et al with Planer Plc has developed an automated LT design with potential for clinical application.

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BBMRI.se overview: Entering the era of large-scale medicine

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BBMRI.se (Biobanking and Molecular Resource Infrastructure of Sweden) is a large-scale national infrastructure programme funded by the Swedish National Science Council (Vetenskapsrådet). BBMRI.se is part of the European Research Infrastructure Consortium (BBMRI-ERIC). In Sweden, BBMRI.se links and works together with 6 different medical universities, and with the Karolinska Institute as Host University. The aim of BBMRI.se is to emphasise the scientific aspects of biobanking so as to guarantee top quality research and development. Its mission is to ensure the collection of high-quality samples, as well as to stimulate collaboration between researchers, biobanks and analytical platforms. Our final goal is to build a national infrastructure of biobank samples from healthy and sick individuals that can be used in research to solve the riddle of “why do some individuals get sick when others do not?”

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