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Bacterial nano-cellulose (BNC) is a novel non-degradable material that is biocompatible and functionally competent for blood vessel tissue-engineering (TE) applications. It has also been shown to promote chondrocyte adhesion. To determine its potential for ear cartilage TE, this work investigates (1) whether BNC mechanical properties can be tuned to match native ear cartilage, and (2) whether BNC scaffolds can be produced in complex shapes; ie. the human auricle. BNC samples (n = 78) with varying nominal cellulose content (2.5 - 15%) were compared biomechanically with human ear cartilage (n = 22) using stress-relaxation indentation. Additionally, a patient-specific BNC prototype was produced from an MRI scan of a human auricle. The results show that equilibrium modulus (Eeq) of BNC was correlated to cellulose density ($R2 = 0.6$); and despite significantly different characteristic relaxation times ($\tau$; $p < 0.05$), Eeq of BNC at 15% cellulose content reached the mechanical properties of ear cartilage (BNC: 2.4 ± 0.4 MPa and cartilage: 2.4 ± 1.1 MPa). This work shows that BNC can be tuned to match native ear cartilage Eeq, and fabricated in to patient-specific shapes. Future work will be focussed on further enhancing BNC mechanics; specifically relaxation characteristics. Alongside positive progress in cell culture efforts, BNC provides promise for engineering ear implants with good mechanical properties and patient-specific shapes. Funding: SNSF and ERA-NET/EuroNanoMed.

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