Abstract

Reconstruction using cartilage tissue is necessary to address deformities of the nose, ears, and maxillofacial region in several cases. However, autologous cartilage tissue transplantation is limited in the amount that can be harvested owing to invasiveness to the human body. Moreover, artificial materials such as implants cannot be used in many situations, given their potential to induce reactions to foreign bodies. Therefore, there is a growing demand for biomaterials that are less likely to cause foreign body reactions. Given that a tissue with a functionally superior three-dimensional structure can replace autologous tissue and artificial materials, we have developed a three-dimensional cultured cartilage tissue without scaffolding material and are working toward its practical application. To achieve an off-the-shelf product that allows prolonged storage, the tissue was fixed with glutaraldehyde to maintain high strength for subsequent processing and management. Although tissue fixation with glutaraldehyde may cause calcification due to the deposition of calcium phosphate, calcification can be prevented by washing with high-concentration ethanol. We generated three-dimensional cultured cartilage tissues using induced pluripotent stem cell-derived limb bud mesenchymal cells and an original cell self-culture aggregation method. The generated tissues were subjected to an anti-calcification treatment with glutaraldehyde and 80% ethanol. The treated tissue had improved stability and strength with minimal calcification. The tissue retained its physical properties that were effectively processable and could be processed into an ear-like shape.

Keywords: glutaraldehyde, prevention of calcification, tissue-engineered cartilage, cell self-aggregation technique, human induced pluripotent stem cells