[P65] ACELLULAR FISH SKIN GRAFT'S STRUCTURE AND BIOACTIVITY IS BETTER PRESERVED COMPARED TO MAMMALIAN DERIVED SCAFFOLDS DUE TO LESS HARSH PROCESSING

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Aim: Acellular fish skin grafts are remarkably similar to human skin in its basic structure. Yet the fish skin graft is fundamentally different from other mammalian derived scaffolds due to structural preservation and lipid preservation. While mammalian scaffolds require harsh chemical processing to reduce disease transmission risk (including viral and prion transmitted diseases), such risk from the Atlantic cod (Gadusmorhua) to humans is nonexistent. Therefore, fish skin graft is subjected to gentle processing that preserves its structure and its bioactive compounds, including omega-3 polyunsaturated fatty acids (PUFAs). Previous studies have shown that omega-3 fatty acids have anti-viral and anti-bacterial properties and also act as regulators of inflammation. Double blind randomized clinical trials have shown that acellular fish skin grafts promote significantly faster healing when compared to porcine small-intestinal derived scaffolds. A variety of other studies on the fish skin grafts, including acute wounds, oral wounds, burn wounds and dura replacement, have been performed with promising results. The acellular fish skin is currently being used in a regulatory approved and patented wound treatment product being marketed in the US and in Europe under the brand name Kerecis Omega3. We set out to evaluate the following biological properties in fish skin and mammalian derived scaffolds: micro-structure, bacterial barrier, hemostatic properties, omega-3 PUFA content and cellular infiltration.

Method: The scaffold structure was examined with scanning electron microscopy (SEM). NIH 3T3 fibroblasts were seeded onto a defined area of scaffold and cultured for 7-14 days. The scaffolds were stained with either hematoxylin and eosin (H&E) or fluorescent markers. Two chamber model was used to test bacterial barrier properties, with sterile broth in one of two chambers and broth with bacteria in the other. Effect on blood clotting was tested with the Lee White test. Lipids were extracted from the fish skin graft and omega-3 content examined with gas chromatography.
Results: Micro-structure of the fish skin grafts is highly porous, generally 10-100 µm in diameter while the micro structure of other biological scaffolds examined were denser and less porous. The acellular fish skin grafts possess superior ability to support three-dimensional ingrowth of cells when compared to human amnion/chorion membrane ($P<0.0001$). The material also acts as a barrier to bacterial invasion for over 48 hours in a two-chamber model at 37 °C. The fish skin graft had significantly faster aggregation effect compared to bovine pericardium collagen matrix ($p \leq 0.05$). The acellular fish skin graft contains EPA and DHA omega-3 fatty acids.

Results/Discussion: Micro-structure of the fish skin grafts is highly porous, generally 10-100 µm in diameter while the micro structure of other biological scaffolds examined were denser and less porous. The acellular fish skin grafts possess superior ability to support three-dimensional ingrowth of cells when compared to human amnion/chorion membrane ($P<0.0001$). The material also acts as a barrier to bacterial invasion for over 48 hours in a two-chamber model at 37 °C. The fish skin graft had significantly faster aggregation effect compared to bovine pericardium collagen matrix ($p \leq 0.05$). The acellular fish skin graft contains EPA and DHA omega-3 fatty acids.

Conclusion: The importance of the structural preservation in biological scaffolds was demonstrated with cell ingrowth studies. Based on these histologic findings fish skin derived graft showed significant ability to support three-dimensional cell infiltration compared to human amnion/chorion membrane. The native omega-3 PUFAs content of the fish skin graft might play a key role in its ability to resist bacterial invasion. These results also show that structural preservation and the biomechanical properties of the fish skin graft provides a supportive environment for cellular infiltration.