Laminin

Laminins are high-molecular weight (~400 to ~900 kDa) proteins of the extracellular matrix. They are a major component of the basal lamina (one of the layers of the basement membrane), a protein network foundation for most cells and organs. The laminins are an important and biologically active part of the basal lamina, influencing cell differentiation, migration, and adhesion.

Laminins are heterotrimeric proteins that contain an α-chain, a β-chain, and a γ-chain, found in five, four, and three genetic variants, respectively. The laminin molecules are named according to their chain composition. Thus, laminin-511 contains α5, β1, and γ1 chains.

Fourteen other chain combinations have been identified in vivo. The trimeric proteins intersect to form a cross-like structure that can bind to other cell membrane and extracellular matrix molecules.

The three shorter arms are particularly good at binding to other laminin molecules, which allows them to form sheets. The long arm is capable of binding to cells, which helps anchor organized tissue cells to the membrane.

The laminin family of glycoproteins are an integral part of the structural scaffolding in almost every tissue of an organism. They are secreted and incorporated into cell-associated extracellular matrices. Laminin is vital for the maintenance and survival of tissues. Defective laminins can cause muscles to form improperly, leading to a form of muscular dystrophy, lethal skin blistering disease (junctional epidermolysis bullosa) and defects of the kidney filter (nephrotic syndrome).

Mackenzie et al. transected cauda equina ventral roots and proceeded to bridge the proximal and distal stumps with either a type I collagen scaffold coated in laminin (CL) or a collagen-laminin scaffold that was also seeded with Schwann cells (CLSC). Regeneration was assessed by way of serial retrograde labeling.

After accounting for the axonal contributions to intrinsic vs extrinsic tail muscles, they noted a higher degree of double labeling in the CLSC group (58.0 ± 39.6%) as compared to the CL group (27.8 ± 16.0%; $p = 0.02$), but not the control group (33.5 ± 18.2%; $p = 0.10$).

The findings demonstrate the feasibility of using Schwann cell seeded collagen-laminin scaffolds in cauda equina injury repair [1)].

Attachment to and proliferation on the substrate are deemed important considerations when Schwann cells (SCs) are to be seeded in synthetic nerve grafts. Attachment is a prerequisite for the SCs to survive and fast proliferation will yield large numbers of SCs in a short time, which appears promising for stimulation of peripheral nerve regeneration. The aim of the present study was to compare the adhesion and proliferation of human Schwann cells (HSCs) on different substrates. The following were selected for their suitability as an internal coating of synthetic nerve grafts; the extracellular matrix proteins fibronectin, laminin and collagen type I and the poly-electrolytes poly(d-lysine) (PDL) and poly(ethylene-imine) (PEI). On all coatings, attachment of HSCs was satisfactory and comparable, indicating that this factor is not a major consideration in choosing a suitable coating. Proliferation was best on fibronectin, laminin and PDL, and worst on collagen type I and PEI. Since nerve regeneration is enhanced by laminin and/or fibronectin, these are preferred as coatings for synthetic nerve grafts

seeded with SCs [2].

1)
Mackenzie SJ, Yi JL, Singla A, Russell TM, Osterhout DJ, Calancie B. Cauda equina repair in the rat: Part 3. Axon regeneration across Schwann cell seeded collagen foam. Muscle Nerve. 2017 Jul 26. doi: 10.1002/mus.25751. [Epub ahead of print] PubMed PMID: 28746726.
2)
Vleggeert-Lankamp CL, Pêgo AP, Lakke EA, Deenen M, Marani E, Thomeer RT. Adhesion and proliferation of human Schwann cells on adhesive coatings. Biomaterials. 2004 Jun;25(14):2741-51. PubMed PMID: 14962553.