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**Artificial implants for peripheral nerve regeneration**

Traffic accidents and other types of injuries frequently cause peripheral nerve lesions, which require surgical intervention to reconnect the separated nerve fibers. In case of larger lesions, a restoration by insertion of an autologous nerve graft or an artificial nerve conduit is necessary. Repair with artificial nerve bridges used in the clinic consist of empty tubes, which are only suitable for the repair over short distances and have limited success. In our latest study we incorporated sub-micron scale fibers of biodegradable poly-ε-caprolactone (PCL) and collagen/PCL blends in a gelatin matrix as guidance structures into an artificial nerve conduit, which consisted of a hollow collagen tube. The efficacy of these structures for peripheral nerve regeneration was tested in 15 mm nerve bridges of the rat sciatic nerve. After twelve weeks of recovery, the outcome was assessed with electromyography and histological evaluation of nerves and leg muscles. Functional repair was measured with behavioral tests every week during the entire recovery period. While collagen tubes were still present after two weeks, all artificial implants were completely resorbed by twelve weeks. Electromyography and the recovery of motor functions demonstrated functional regeneration in all autologous transplants, in 12/13 artificial implants with an internal structure and in half of the empty nerve bridges. In the experimental groups, the return of motor functions was retarded by two to three weeks compared to the autografts. The extent of recovery (compound muscle action potentials, functional indices, reversal of muscular atrophy) of implants with PCL and collagen/PCL fibers was significantly superior to empty implants but not as good as achieved with autologous nerve transplantation. Axonal regeneration was observed in all groups except for the negative control, and the share of regenerating motor axons remained proportional to the situation in the non-lesioned nerve. In conclusion, the incorporation of longitudinal polyester fibers as internal guidance structures constitutes a significant progress towards the replacement of nerve transplantations by cell-free artificial nerve bridges.


