

Peripheral nerve conduits: technology update

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Abstract: Peripheral nerve injury is a worldwide clinical problem which could lead to loss of neuronal communication along sensory and motor nerves between the central nervous system (CNS) and the peripheral organs and impairs the quality of life of a patient. The primary requirement for the treatment of complete lesions is a tension-free, end-to-end repair. When end-to-end repair is not possible, peripheral nerve grafts or nerve conduits are used. The limited availability of autografts, and drawbacks of the allografts and xenografts like immunological reactions, forced the researchers to investigate and develop alternative approaches, mainly nerve conduits. In this review, recent information on the various types of conduit materials (made of biological and synthetic polymers) and designs (tubular, fibrous, and matrix type) are being presented.

Keywords: peripheral nerve injury, natural biomaterials, synthetic biomaterials

Introduction

Peripheral nerve injury is a worldwide clinical problem that impairs the patient's quality of life. The central nervous system (CNS) consists of the brain and the spinal cord. The peripheral nervous system, on the other hand, is located outside the CNS and includes the cranial, spinal and peripheral nerves that conduct impulses from and to the CNS. Injury in peripheral nerves could lead to loss of neuronal communication along sensory and motor nerves between the CNS and the peripheral organs. Peripheral nerve injuries often result in painful neuropathies via reduction in motor and sensory functions and can be catastrophic for patients, drastically affecting their daily activities.¹ Peripheral nerves are composed of bundles of nerve fibers and surrounding connective tissue sheaths including blood vessels (Figure 1). Each individual nerve fiber and the supporting Schwann cells are surrounded by a loose connective tissue, the endoneurium. A bundle of nerve fibers is held by collagen fibrils in the connective tissue and form fascicles surrounded by a dense connective tissue called the perineurium. Entire nerve fascicles within a nerve trunk are completely ensheathed by a dense and irregular connective tissue called epineurium, which is the outermost layer of connective tissue sheaths.

In general, peripheral nerve injuries are caused by mechanical, thermal, chemical, or ischemic damages resulting mainly from traumatic accidents or some degenerative disorders. The severity of the injury determines the functional outcome. Peripheral nerve injury is commonly assessed according to the Seddon and the Sunderland classifications.²⁻⁴ Seddon² categorized the injuries in increasing severity as neurapraxia, axonotmesis, and neurotmesis.² A few years later, Sunderland classified them as