# RECENT TRENDS IN MANAGEMENT OF PERIPHERAL NERVE INJURIES

**Essay**
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# List of Tables

# List of Figures

## Contents Page

# Introduction

# Introduction

The repair of the peripheral nerves has had a long a history. Inadequate and inaccurate concepts of the physiology of peripheral nerves had delayed surgical treatment of lesions of nerves for many years **(Lundborg et al., 1981)**.

An important feature of the peripheral nervous system in comparison with the central nervous system is its remarkable capacity for recovery through both re-myelination and regeneration of axons **(Grand et al., 1999)**.

Although the ability of peripheral nerve to regenerate following injury is well known , the basic mechanisms and factors controlling nerve regeneration are a mystery **(Seckel et al.,1984)**.

Before thinking in the different ways of management of peripheral nerve injuries , diagnosis and documentation must be done clinically and using electro-physiological studies **(Grand et al., 1999)**.

The clinical treatment of a peripheral nerve injury involves either surgical realignment of the individual nerve fascicles (primary neurorrhaphy) or the use of an autologous nerve graft to bridge larger defect. The success of regeneration , however, can be variable and functional recovery is rarely complete. Recent insight into the neurosciences , combined with other advances in nerve cell culture , genetic techniques and the development of novel biomaterials , provides optimism for the improved surgical treatment of peripheral nerve injuries **(Hudson et al., 2000)**.

Tissue engineering in the peripheral nervous system aims to create either natural or synthetic tubular nerve guidance channels as alternatives to nerve auto grafts **(Hudson et al., 2002)**.

# Aim of the work

The aim of this work is to review the literature of the management of cases with peripheral nerves injuries based on the new concepts of nerve regeneration.

# Review of Literature

# ANATOMY AND HISTOLOGY OF THE PERIPHERAL NERVES

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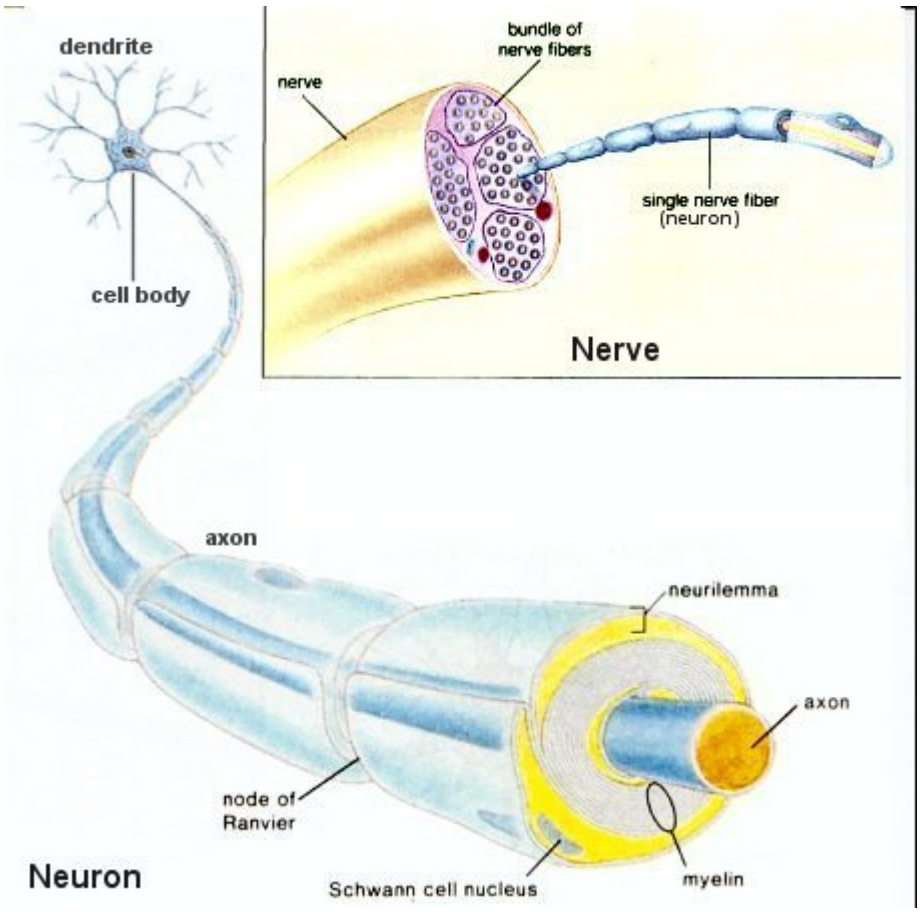
The nervous system is made up of billions of cells called neurons. The typical neuron consist of a cell body (soma) which has many radiating processes called dendrites, which are specialized to receive signals from other neurons, and a single long process the axon, which is capable of generating nerve impulse and conducting it ***(Angevine, 1997).***




**Fig(1): The neuron**

***(Angevine, 1997).***

The nerves of the peripheral nervous system consists of varying number of myelinated and unmyelinated axons originating from certain located in the brain or spinal cord ***(Angevine, 1997).***

## The axon

The axon arises from a conical extension of the cell body, the axon hillock. The axon is more slender and usually very much longer than the dendrites of the same cell. It is a cylindrical process that varies in length and diameter according to type of neuron ***(Junqueira and Carneiro, 1980).***

Unlike the dendrites which diminishes in diameter as they branch, the axon has essentially the same caliber through out its length. In spinal motor neurons supplying muscles of the feet, the axon may be as much as 40 inches in length ***(Angevine, 1997).***

The axon contains the axoplasm which is a viscous fluid enclosed in a surface membrane, the axolemma, which is about 65-80 A° thick The axolemma is composed of a phospholipid bilayer into which are inserted protein molecule that have a central channels or pores which can open or close in response to changes in membrane voltage. ***(Siegelbaum and Koester, 1991)***

Histologically, peripheral nerve fibres may be divided into myelinated and unmyelinated varieties on the basis of absence or presence of myelin sheath ***(Siegelbaum and Koester, 1991)***

Most axons in adult nerve tissue are ensheathed by single or multiple folds of sheath cell. In peripheral nerve fibers, the sheath cell is the schwann cell, or neurolemma sheath. Axons of small diameter are usually un-myelinated nerve fibers; thicker axons are generally ensheathed by myelin sheath ***(Junqueira and Carneiro, 1980).***

The myelin sheath is a highly refractile layer. The lipids that make up the bulk of this layer (cholesterol, phospholipid and glycolipids) are extracted in a specimen preparation for light microscopy. ***(Angevine, 1997).***

At intervals along the axon, there are short gaps in the myelin sheath, called the *nodes of Ranvier*. These are spaces between the successive Schwann cells of the sheath. ***(Angevine, 1997).***

The myelin sheath of peripheral nerves begins a short distance from the cell body. The port of the axon between the axon hillock and the beginning of the sheath is called its *initial segment.* The presence of the myelin sheath greatly influences the ability of an axon to conduit on impulse. It acts as an insulator with the axon exposed to the extracellular space at the nodes of Ranvier. The inter-nodal segment of the myelin sheath prevent the inter change of ions necessary to generate an action potential. However the action potential is regenerated at each node of Ranvier. This is called *saltatory conduction* and is very much faster than in axons lacking myelin sheath. ***(Angevine, 1997).***

## Classification of nerve fibers :

The individual axons are of different sizes, varying in diameter from 1 to about 20 um. There is direct proportional relationship between total fiber

diameter and conduction velocity ***(Rushton, 1951)***. A number of different systems have been proposed to classify the fibers on basis of their diameter and the function subserves. ***Erlanger and Gasser 1937*** classified nerve fibers based on their sizes into A, B and C fibers. The A group can be further subdivided into Alpha , Beta , Gamma and Delta fibers, again based on their sizes and respective conduction velocities. ***Lloyd 1943*** introduced a classification using roman numerals I through IV for fibers in descending order of size.

| **Lloyd classification** | **Erlanger & Gasser classification** | **Greatest fiber diameter (µm)** | **Greatest conduction velocity (m/sec)** | **Function** |
|---|---|---|---|---|
| I | A-alpha | 22 | 120 | Efferent motor & proprioceptive fibers |
| II | A-beta | 13 | 70 | Crude touch, pressure & vibratory fibers |
| | A-gamma | 8 | 40 | Fine touch and pressure fibers |
| III | A-delta | 5 | 15 | Pain & temperature fibers |
| IV | B | 3 | 14 | Preganglionic autonomic fibers |
| | C | 1 | 2 | All postganglionic autonomic fibers & unmyelinated pain fibers |

**Table 1** : Classification of nerve fibers ***(Worth, 1996)***

### The Schwann cells (Lemocytes)

Schwann cells are satellite cells of the peripheral nervous system; all peripheral axons are ensheathed by them. They participate in the supply of metabolites and trophic factors to the axons, and in the maintenance of ionic state of the periaxonal space. . ***(Williams et al., 1992).***

The close interrelation of axons and Schwann cells is confirmed by their mutual reactions to injury. Crushing or cutting of the nerve fiber produces wallerian degeneration. In this reaction, axons distal to the site of injury degenerate and an intense proliferation of schwann cells follows in which myelin and axonal debris are phagocytosed. This will leave a tube consists of Schwann cells. ***(Williams et al., 1992).***

## Dendrites

Structurally, dendrites are very similar to perikaryons, however they are devoid of golgi bodies. Nissel bodies and mitochondria are present except in very thin dendrites. Neurofilaments and microtibules are more numerous in dendrites then in axons ***(Angevine, 1997).***

## The Perikaryon or Soma

It is part of the neuron that contains the nucleus. It is the primarily trophic factors producing center, and also has a receptive function. The perikaryon of most neurons receives a great number of nerve endings that convey excitatory or inhibitory stimuli generated in other nerve cells ***(Junqueira and Carneiro, 1980).***