# RESULTS
# OF THE SURGICAL TREATMENT
# OF PERIPHERAL NERVE INJURIES
# OF THE UPPER LIMB

THESIS

SUBMITTED IN PARTIAL FULFILMENT

OF REQUIREMENTS FOR THE

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By

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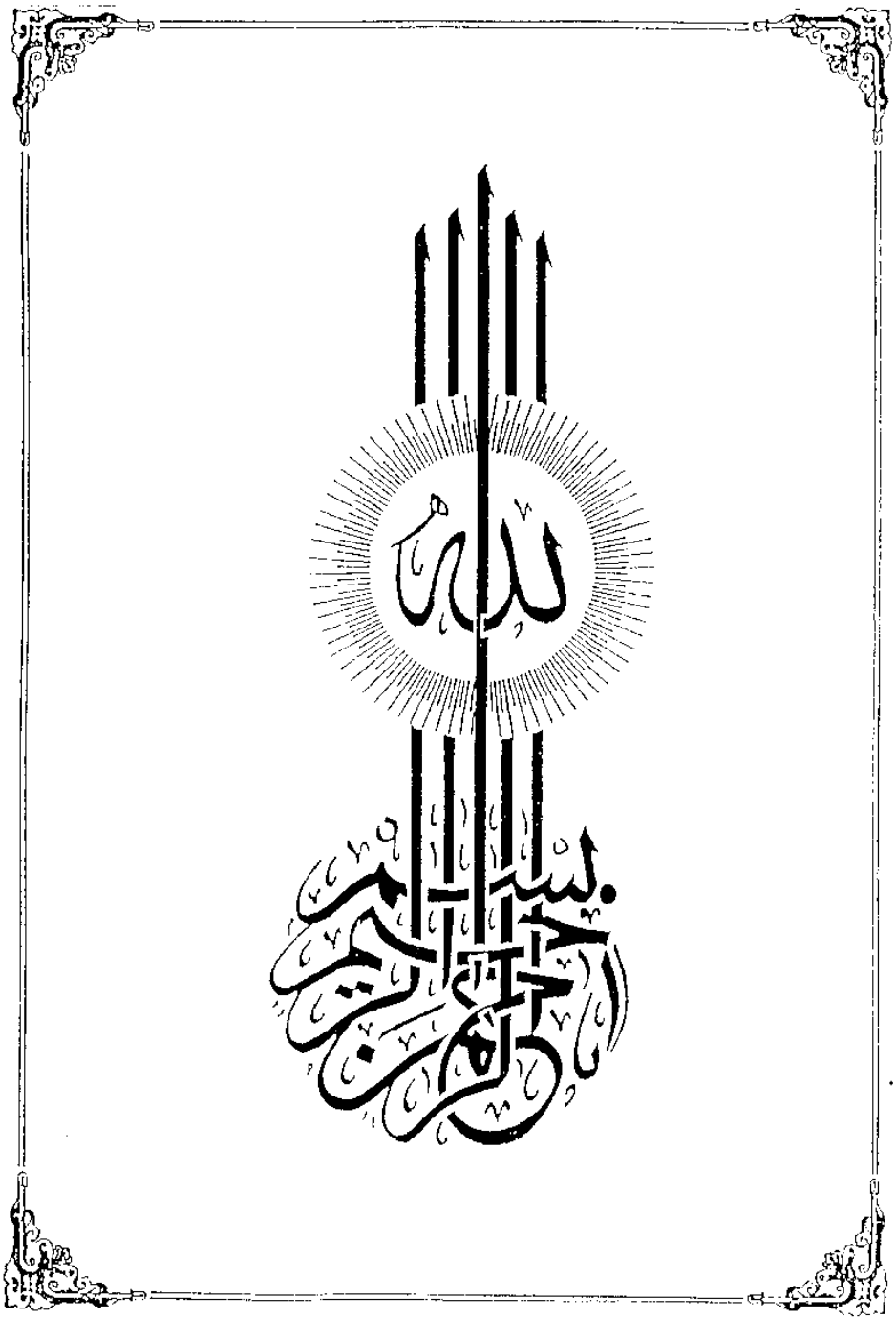

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## AIM OF THE WORK

The aim of this work is to study the results of the surgical treatment of traumatic peripheral nerve injuries of the upper limb.

Special interest has been directed to the type of the injury, time elapse between the injury and the repair and the procedure adopted for the repair of the injured nerve.

CONTENTS

# 1- REVIEW OF LITERATURE

# INTRODUCTION

Inadequate and inaccurate concepts of the physiology of peripheral nerves deterred and delayed surgical treatment of lesions of nerves for many years.

In the Hippocratic period failure to distinguish between peripheral nerves and tendons led to considerable confusion, and the concept was advanced that a divided nerve would not unite whatever therapy was employed.

Early isolated attempts at nerve suture were reported as the one by Rhazes in the 9th century, as quoted by De Vigo, those of William of Saliceto described by Guy De Chauliac and Lanfrank (13th century) and by Gabriele Ferrara in the 17th century.

However, during these periods most physicians and Surgeons opposed sutures of nerves. Others believed that spontaneous recovery occured in many instances and that consequently surgical interference may delay this recovery.

Physiological investigations as those by Cruich Shank and Haighton in the 18th century, finally demonstrated that recovery of nerve function was dependent upon down-growth of axons from the proximal end of the nerve to the appropriate muscle and skin area peripherally.

Recognition of this was slow even as late as 1864,

Wier Mitchell in discussing Civil War wounds made no mention of surgical repair of nerves. By 1872, however he advocated nerve suture and favourably influenced the use of surgery.

In 1882, Mikulikz used what was now been termed the sling suture, or a suture placed through the proximal and distal ends of the nerve for apposition.

During World War I, several reports in French literature emphasized the value of early exploration and of neuroma resection and sheath suture.

In World War II, great numbers of peripheral nerve injuries were treated surgically in the English and United States military services. In the former under the guidance of Seddon (1947) and Guttman. Wide exposure and freeing of extensive lengths of nerves to permit approximation of good nerve to good nerve without tension was emphasized.

The introduction of magnification during surgery of peripheral nerves was first described by Jacobson (1963) a general surgeon. He demonstrated that the two requirements in good peripheral nerve surgery i.e. delicate handling of the tissue and adequate approximation of nerve ends with funicular orientation was easily fulfilled with the operating microscope.

Smith (1964), a famous plastic surgeon, Kuraze (1964), Michon and Massè (1964), Millesi et al. (1967) all reported that microsurgical techniques in peripheral nerve surgery are superior to convential methods of surgery.

Braun (1966), Ellis (1967) and Seddon (1968) stated that they found no benefit of microtechniques over other methods. Despite some resistance, microsurgical techniques in peripheral nerve surgery is flourishing (Millesi, Sami et al., and others).

## Anatomy and Histology of Peripheral Nerves

The nerves of the peripheral nervous system communicate with certain parts of the brain stem (cranial nerves) or the spinal cord (spinal nerves) and branch all over the body.

Within one nerve, the individual anatomical units are the nerve fibres. These themselves contain one or more individual conducting units, the axons.

### Peripheral Nerve Fibres :

Histologically, peripheral nerve fibres may be divided into myelinated and non-myelinated varieties on the basis of the presence or absence of a readily demonstrable sheath of myelin.

The nerve fibres are composed of a central core of axoplasm surrounded by a multilayered sheath.

### The Axoplasm :

The perinuclear cytoplasm of some nerve cells extends beyond the central nervous system as a filamentous process of variable length and thickness. Those processes from the neurones of sympathetic ganglia and the anterior horn cells of the spinal cord are axons. Those connected with the posterior root ganglia neurones are dendrites. Both are

histologically indistinguishable and for this reason the general term axon is applied. Axons vary from a few millimeters to a meter in length. The axoplasm is a viscous fluid enclosed in a surface membrane, the axolemma, which is about 65-80 A° thick. It is composed of two opaque layers separated by a light interspace (Elfvin, 1968 ; Webster, 1974).

Contained in the axoplasm are neurotubules, neurofilaments which represent its main constituents, mitochondria, endoplasmic reticulum and granular and vesicular structures.

The neurotubules are approximately 200 A° in diameter and have a dense rim surrounding a pale core. The neurofilaments are finer 70-100 A° in diameter. Weiss and Mayr (1971) have introduced the concept of continuous neurotubular growth and replacement. Whereby, the tubules originate in the cell body as protein subunits and are then bond to form a linear sequence which coils to form a tubular structure. The later is carried distally with the advancing axonal column. At the periphery, subunits of the tubules are released and then fragmented into vesicles or are dissipated by dissolution. In non-myelinated fibres neurotubules out number neurofilaments the reverse arrangement is found in myelinated fibres (Freide and Samoragski, 1970).

Microtubules are essential to axoplasmic flow (Davison , 1970) and may actually be connected to the central cell's nucleus.

Axonal excitability seems to be a function of axoplasmic flow, and without intact intracellular ultrastructures, excitability is lost (Spencer et al., 1973).

Slow, rapid and retrograde phases of axoplasmic flow have been demonstrated with axons (Samson, 1971).

It is of interest that certain cytoplasmic structures and organelles are not found in the axon; e.g. the golgi apparatus, no rough surfaced endoplasmic reticulum and no free ribosomes or polysomes.

The Nerve Sheath :

Electronmicroscopy has revealed details of the formation and fine structure of the nerve fibres that cannot be detected by light microscopy. Surrounding the axon is a multilayered sheath which presents more complex features in myelinated fibres.

a) The Sheath of Non-Myelinated Fibres :

This consists of a single layered chain of Schwann cells, external to which is a basement membrane surrounded by an encircling connective tissue covering, the endoneurium.

The Schwann cell envelops several axons, each of which is left attached to the surface of the cell by a fine mesaxon. The Schwann cells form a continuous longitudinal chain, one cell in thickness, along the entire length of the embedded axons. Elecrton-microscopy has clearly demonstrated cell boundries at the zone of contact between adjacent Schwann cells. This zone is characterized by the formation of Schwann cell cytoplasmic processes, those of neighbouring cells overlap and interdigitate to ensure complete insulation of the axon.

b) The Sheath of Myelinated Nerve Fibres :

Myelinated fibres form the bulk of the elements of the somatic nervous system.

They have a multilayered sheath consisting of Schwann cell myelin complex internally and a connective tissue layer externally, the two being separated by a basement membrane.

Immediately surrounding the axon is a layer of myelin which, longitudinally is broken into segments. This segmental arrangement outlines the nodes and internodes of the nerve fibre.

In the peripheral nervous system axons grow out from the central and ganglionic cell bodies along with the Schwann cells which initially multiply as the nerve grows in length

but later they cease multiplying and increase only in size. At first all axons are non myelinated, but later a flap-like extension of Schwann cell cytoplasm begins to spiral around the neurite. As development proceeds more and more spirals are made and these become transformed into compacted layers of cell membrane (Robertson, 1955).

In electron micrographs, the myelin sheath is seen as a laminated structure with regular dense periods alternating with less conspicious intraperiod lines, representing apposition between the external surfaces of plasma membrane.

Suitable osmotic treatment which causes swelling of the sheath causes the intraperiod line to split, showing that the external surfaces are not fused but are apparently able to move on one another (Robertson, 1955).

Investing the myelin sheath, and intimately related to it, is a single layer of flattened Schwann cells, which at each node reaches and embraces the axon which is constricted at this site.

Each internode carries one Schwann cell nucleus which is situated approximately midway between adjacent nodes and indents the subjacent myelin.

Besides the participation of Schwann cells in myelination and their behaviour during degeneration and regeneration of nerve fibres other functions are attributed to