DECOMPRESSION TECHNIQUE FOR MORTON'S NEUROMA

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The treatment of Morton's neuroma has consisted of surgical removal of the intermetatarsal nerve which supplies the digits, without much concern of a recurrent neuroma. In fact, a recurrent neuroma will form. Whether it is symptomatic or asymptomatic depends upon where the nerve is situated in the surrounding tissue. A virgin neuroma develops from chronic compression of the nerve with increased thickening of the surrounding connective tissues. This thickening is a protective mechanism of the body. Before discussing the effects of decompression, the peripheral nerve will be described.

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The peripheral nerve is classified by fiber size and whether it is myelinated or not. Group A are myelinated fibers, and are further subdivided by fiber size and function. (Table 1). Group C fibers are unmyelinated, are 1-2 micrometers in size, and their function is burning pain. The discussion will be concerned with the Group A myelinated nerves serving the sense of touch.

Mountcastle found that Group A myelinated nerves serving the sense of touch could be subdivided into slowly-adapting fibers, and quickly-adapting fibers based upon their adaptation to a constant-touch stimulus. Slowly-adapting fibers convey information regarding constant touch and pressure. This is determined by a static two point discrimination. The ends of a caliper are held in constant contact with the skin and the innervation density of the slowly-adapting fiber/receptor population is measured. Quickly-adapting fibers detect moving touch. These fibers are determined by a moving two point discrimination test. The two ends of the caliper are moved and a determination of one point or two points are determined.

TABLE 1

Classification of Group A Peripheral Nerves

GROUP A

A-Delta
Size: 2-5 micrometers
Function: Sticking pain and Temperature

A-Beta
Size: 10-15 micrometers
Function: Touch

A-Alpha
Size: 15-20 micrometers
Function: Motor Fiber

Mechanoreceptors or end organs transform a mechanical stimulus into a neural impulse. Pinkus and Lowenstein demonstrated that the Merkel cell neurite, and the Pacinian corpuscles along with the Meissner corpuscles are the mechanoreceptors responsible for the slowly-adapting and quickly-adapting fiber receptor systems respectively.

Vibration stimuli can also determine subpopulations of Group A-beta fibers. Vibration or the "sense" of flutter-vibration is another touch sub-modality. The nerve fibers that mediated the perception of vibratory stimuli are the large myelinated fibers, the group A beta fibers, and they are characterized as belonging to the quickly-adapting fiber group. Therefore, vibratory stimuli are mediated by the same nerve fiber population that mediated the perception of moving-touch.

The perception of low frequency vibratory stimuli, 30 cycles per second, is mediated by a quickly-adapting fiber/receptor system, the Meissner corpuscle in glabrous skin, and the hair follicle lanceolated endings in the hairy skin. The perception of high frequency vibratory stimuli, 256 cycles per second is mediated by a quickly-adapting fiber/receptor system, the pacinian corpuscle in glabrous skin, and the hair follicle lanceolated endings in the hairy skin.

Clinical evaluation of the patient's vibratory perception tests the same pathway of moving touch through the use of a tuning fork. Because a tuning fork stimulus is usually a new experience for the patient, during testing, the patient need only answer whether or not he perceives "something" and compare it to the same test on the opposite extremity.

The 30 cycle per second tuning fork is best to evaluate the Meissner afferent, (the quickly-adapting fiber receptor system located in the superficial dermis). The 256 cycles per second tuning fork is best to evaluate the Pacinian afferents, (the quickly-adapting fiber/receptor system located in the deep dermis and subcutis). Both are needed if the physician is following the recovery of sensation after nerve injury, deciding the appropriated timing and phase of sensory re-education, and investigating peripheral sensibility.

Clinical evaluation of nerve injury, either nerve compression or nerve division with the use of a 30 cps, 256 cps tuning fork and testing two point and moving two point discrimination can accurately diagnose nerve injury. The standard pin prick test for nerve evaluation only tests the Group A myelinated Delta nerves subserving the stimulus of sticking pain and temperature. This pin prick does not test the Group A Myelinated Beta nerves subserving touch. Therefore when a physician in the emergency room is testing the medial plantar nerve for the function of sensory and uses the pin prick test, and elicits pain, the theory that the sensory nerve is intact is wrong. What is intact is the Group A myelinated Delta nerve subserving sticking pain and temperature, not the Group A myelinated Beta nerves subserving sensory.

This theory is most important when evaluating the nerve compression syndromes. The peripheral nerve is a mixed nerve having fibers varying in size from 1 to 2 Micrometers (C-fibers) to 25 Micrometers (A-Alpha fibers, Motor). However the sensory component of the mixed nerve has a very large percentage of A-Beta fibers, 15 to 20 micrometers, the "touch fibers".

When a local anesthetic is injected around a mixed nerve, it crosses the epineurium via diffusion. The thinnest nerves are affected first, which are subserved by temperature and pain. Therefore the loss of touch, movement and pressure are the last perceptions to be lost.

When ischemia of a peripheral nerve is produced, the oxygen tension is reduced in the vessels that supply the nerve. The oxygen gradient from inside the vaso nervosum to the axoplasm decreases. The large nerves, with more axoplasm, are affected by the decreased gradient sooner than the thin nerves, whose smaller diameter allows the available oxygen to still supply its needs at a time when the large fibers cease to function. Therefore with ischemia, the first perceptions to be lost are those of the large fibers; touch. Pain perception is lost last.

When direct pressure is applied to a nerve, the force applied to the epineurium is distributed throughout the fascicles to the axons. The largest axons will directly press upon the nearest axon. Large axons will abut large axons. Therefore, the first perceptions to be lost are those of the larger nerves; touch. Pain perception will be lost last. Clinical diagnostic testing of a mixed nerve should not be done with a pin or a needle, but with a tuning fork to evaluate the perception of touch.

When the peripheral nerve is compressed, as in Morton's neuroma, vibratory perception of the digits in comparison to the ipsilateral digits and that of the contralateral limb are abnormal. Commonly the first alteration of nerve compression is one of hypersensitivity. For example, a patient with a nerve compression of the third intermetatarsal space of short duration may observe that the feeling caused by the tuning fork touching the digit is "more sensitive" or "more electric". It is therefore possible that early in the course of neural ischemia (compression), the state of hyperesthesia is present. The examiner must be aware of this possibility. Long duration compression of the intermetatarsal nerve will result in the classical description of decreased sensory input.

The question arises when a physician is presented with a nerve compression syndrome in the foot or leg, whether the first surgical consideration should be removal of the nerve. The suggestion of initial decompression of the nerve with possible relocation of the nerve to alleviate compression should be considered.

The complications of recurrent intermetatarsal neuroma can be severe and extremely disabling. In light of the potential for significant complication, primary resection of Morton's neuroma is a method of treatment which deserves a degree of re-examination. Decompression and relocation of the digital nerve is an alternative that deserves investigational attention. A thorough working knowledge of nerve pathology and function is essential not only in the preoperative evaluation of the condition, but also in the postoperative analysis of this new surgical approach to an old problem.

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