MEDIAN AND ULNAR NERVE INJURIES: PROGNOSIS AND PREDICTORS FOR CLINICAL OUTCOME

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Introduction: This study investigated the overall long-term outcome of median and ulnar nerve injuries. Furthermore the end-point for functional recovery has been determined and predictors for the different outcome markers have been quantified.

Materials & methods: A longitudinal cohort study (n=136), with a mean follow-up of 5.5 years, and a meta-analysis (n=623) were performed. Parameters of outcome were sensory recovery (Semmes-Weinstein monofilaments and MRC scale), motor recovery (Grip, Tip-pinch strength and MRC scale), restoration of activities of daily living (Functional Symptom Score), psychological morbidity (Impact of Event Scale) and the ability to return to work.

Results: Our meta-analysis showed that 44% of the median nerves reached 'good' (S3+ or better) sensory recovery and 61% 'good' motor recovery (M4 or better). For ulnar nerve injuries 41% reached 'good' sensory recovery and 45% 'good' motor recovery. Combined median-ulnar nerve injuries and 'spaghetti wrist' injuries had worse prospects. 59% of the study population was able to return to work within 1 year and the mean time off work was 31 weeks. On average 5.5 years following surgery the FSS was 19. 36% of the subjects reported sufficient early post-traumatic psychological stress, at one month post-operatively, to be in need of psychological treatment (Impact of Event Scale >30). A significant improvement of sensory recovery was found up to 4 years following surgery. Motor recovery stabilised three years post-operatively. Age, delay, level of injury, cognitive capacity, type of injury, compliance to hand therapy and early psychological stress seemed to be significant predictors for final outcome. Furthermore the results of a study on cold intolerance will be provided.

Discussion: Despite all the efforts to improve functional outcome following nerve injuries the clinical outcome is still far from ideal. The central nervous system is one of the leading predictors for clinical outcome. Early collaboration with a psychologist is essential to identify those patients who are likely to develop a post-traumatic stress disorder. Quantification of predicting variables will help us to create a prognostic model to predict final functional outcome.

Degradable nerve conduits for clinical peripheral nerve repair

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The use of nerve conduits for the repair of peripheral nerve defects has evolved from a previous experimental idea to a clinical reality over the last ten years.
Numerous experiments in animal models have been extensively utilized and hundreds of studies showed beneficial effects of nerve promoting factors and new methods of nerve repair. More recently, the use of nerve guidance tubes in repairing clinical peripheral nerve injuries gained in popularity.
The presentation focuses on the **clinical** use of FDA en CE approved **degradable** nerve conduits, as well as considerations regarding the use of it.

Reorganization of the brain after changes in the peripheral motor system: implications for hand surgery and rehabilitation

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Many studies have shown that the brain reacts (adapts) almost immediately to changes in the periphery. It has been shown that deprivation of input results into a decrease in the size of neural representations, whereas an increase in input results into an increase in representational space. These mechanisms of neural adaptation have implications for hand surgery. They clearly indicate that surgery is not an intervention limited to the peripheral effector organ (limb) under treatment, but an intervention that leads to adaptive changes in brain areas involved in the control of that organ.
Neural representations are continually updated by means of input from the moving body. Periods of relative immobilization cause cerebral reorganization and impairment of central control. However, recent neuroimaging data showed that relevant input is not only generated by actual movements, but also by the imagination of a movement (motor imagery). During motor imagery more or less the same brain areas become activated as during actual movement. Furthermore, it has been shown that motor imagery can be used for the learning of movements (Mulder *et al* , 2004). The causal mechanism seems to be fully central, that is to say during motor imagery no peripheral activity (muscles, heart rate etc) is observed (Mulder *et al*. 2005).
These are intriguing phenomena. It will be discussed whether it would be possible to use motor imagery for updating neural representations during periods of immobilization.

Mulder, Th., Zijlstra, S., Zijlstra, W., & Hochstenbach, J. (2004). The role of motor imagery in learning a totally novel movement. *Experimental Brain Research,154*, 211-217
Mulder, Th. Zijlstra, S., & De Vries, S. (2005). Observation, Imagination and Execution of an Effortful movement: more evidence for a central explanation of motor imagery. *Experimental Brain Research, 163:* 344-351

Splint therapy in radial nerve lesion

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Long-term pressure on the radial nerve results in a neuropraxis, with a consequent absence of finger and wrist extension. This type of neuropraxis is known as paralyse d'amour or Saturday night palsy. If the humerus is fractured a neurotmesis or axonotmesis can arise.
With a neuropraxis function can spontaneously recovery within 6 to 12 weeks. However in the case of a neurotmesis an operation is necessary and recovery can take up to several months.
Until full recovery we speak of a drop wrist. The patient cannot reach or place objects. Sensibility is absent in the dorsum of the hand however this has little effect on the general hand function.
Until full recovery hand function can be improved by splinting the wrist/hand
What are the treatment possibilities?

1. No splint: the hand can be supinated in order to release an object.
2. Wrist brace: the wrist is stabilised. This facilitates optimal use of the available hand function especially in the elderly
3. Wrist cock-up splint with dynamic finger extension. The outriggers cause this type of splint to be bulky
4. Wrist cock-up splint with limiting flexion of the MCP joint. The intrinsics can extend the DIP and PIP joints.
5. A closed kinetic chain splint. Passive extension of the MCP joint is obtained by active flexion of the wrist. Passive wrist extension is obtained by active flexion of MCP.
6. Recovery of active wrist extensor than provide a small splint
7. No recovery then tendon transfers. Splint for active flexion and passive extension (Kleinert principle)

Hannah in her article *Splinting and radial nerve palsy, 2001* describes in a single subject design that the hand function improved by using either a splint with dynamic extension or a tenodesis splint. However he found that the patient preferred a simple splint.
Splints improve the hand function but are bulky and conspicuous.
The best splint depends on the activities of the patient.

The intelligent hand and the plastic brain

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The human hand is highly specified with refined sensory-motor functions. The sense of touch is essential to provide sensory feedback regulating fine motor movements, and the fine sensory-motor functions of the hand are reflected in large representational areas in motor and somatosensory cortex. The cortical hand map is not static but may undergo rapid functional reorganisational changes based on changes in hand activity and sensory inflow. The cortical hand representation expands as a result of increased hand activity and sensory inflow while the representation may be reduced or disappear as a result of decreased hand activity or various types of deafferentiation such as anaesthesia, amputation and nerve injury.

Injuries to major nerve trunks in the upper extremity, even when repaired with microsurgical techniques, is never followed by complete recovery of fine sensory functions in the hand of adult patients. A major reason is misdirection of outgrowing axons resulting in reorganisation of the cortical hand representation into a mosaic-like, dispersed pattern - "the hand speaks a new language to the brain". Sensory re-educational programs are required to compensate for these changes. In our research we focus on new insights into brain plasticity mechanisms to improve and refine these programs. fMRI is combined with the use of refined tests for hand function. In the initial phase, when there is no sensory inflow from the hand, our aim is to maintain and activate the cortical hand representation by utilising the brains capacity for visuo-tactile and audio-tactile interaction. In the later phase, when reinnervation of the hand is beginning, the effects of sensory re-education can be considerably enhanced by using various types of selective deafferentiation - such as cutaneous anaesthesia of the forearm - which allows the cortical hand representation to expand, hereby recruiting a larger number of neurons in the re-educational process.