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FACTORS INFLUENCING THE FUNCTIONAL OUTCOME AFTER REPAIRING OF MEDIAN, ULNAR, COMBINED MEDIAN – ULNAR NERVES: REVIEW

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Abstract

The injuries at the forearm and wrist levels are a common cause of severe tendon, muscle, and neurovascular damage and can be placed among the severe disabling injuries. Because of the superficial location of these structures at the forearm level, a relatively minor injury can have a devastating impact. Particularly in cases where a nerve is involved, both sensory and motor function may be impaired, resulting in a nonfunctional hand. Upper extremity injuries have been an important cause of morbidity and disability in both the working and nonworking population. The true impact of hand and forearm injuries may be greatly underestimated. Therefore, it is important to evaluate the outcome of the nerve injury and the factors that influence outcomes. The assessment of recovery involves more than evaluation of motor and sensory recovery by a physician. Besides a clinical examination, assessment of the long-term outcome following nerve injury should include a patient-derived assessment of function, evaluation of the return-to-work ratio, and assessment of psychological distress.

The aim of this study is reviewing the contemporary literature, in which factors influencing poor or good outcome after peripheral nerve injury were described. On the basis of this research it is possible to estimate which patients have a high or low chance of successful motor and sensory recovery after median and/or ulnar nerve injury.

Keywords: *median, ulnar nerve injury, functional outcome, prognosis, wrist function.*

The human hand is not only a working tool but also a delicate instrument of great importance for our daily activities and well-being. It is a body part that links us to the outer world by the sense of touch and one that makes our expression to the world heard via body language or via the art of painting or music. The hand has an enormous capacity to perceive, to execute and to express – simultaneously, in the act of touch [*Gibson J., 1962*].

It is known that upper extremity injury is the most common type of work trauma and therefore of major importance from a public health point of view [*Kelsey J. et al., 1997*]. Besides amputation, combined injury of nerves, flexor tendons, and arteries at wrist level may be the most traumatizing injury to the forearm. Nerve injury causes loss of motor and sensory functions of the hand. Diminished grip strength, imbalance of hand movements due to loss of intrinsic muscle functions, and loss of sensation in some or all fingers leave the hand as a nonfunctional tool. Laceration of several flexor tendons can lead to extensive scar tissue formation, resulting in elimination of differential gliding of the tendons [*Yii N. et al., 1998*].

Restoration of motor and sensory functions in the hand after nerve repair is a complex process based on multilevel cellular, chemical, and functional changes – from the fingertips to brain cortex [*Lundborg G., 2004*]. Axonal outgrowth and orientation is dependent on complex molecular mechanisms in the microenvironment with various types of mechanisms for axonal attraction or repulsion, stimulating or inhibiting the advancement of axons. Following transection of a nerve, the reactions at the cell-body

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level lead to a shift in metabolism from a mode of maintenance to a mode of growth expressed in structural and functional changes of the nerve cell bodies [*Lieberman A., 1971*; *Grafstein B., 1975*; *Aldskogius H. and Arvidsson J., 1978; Dahlin L. et al., 1987*]. During axonal transection, a large number of neurones die because of apoptosis. There may be a cellular loss of 20-50% of neurones in the dorsal root ganglia [*Aldskogius H. and Arvidsson J., 1978*; *Ygge J., 1989*; *Liss A. et al., 1996*] and motor cells may also die, although to a lesser extent [*Li L. et al., 1994*; *Novikov L. et al., 1995*]. Several factors may have an influence on the posttraumatic neuronal loss in the dorsal root ganglia such as age, time laps from injury to repair and proximity of injury. The immediate repair of a nerve may reduce posttraumatic cell death [*Ma J. et al., 2003*].

A major problem is that axonal misdirection, regardless of the repair technique, always occurs at the repair so that sensory axons grow into motor Schwann cells and vice versa [*Ramon Y., Cajal S., 1928*; *DeFelipe J. and Jones E., 1991*; *Lundborg G., 2004*; *Witzel C. et al., 2005*]. In the distal segment, there is Wallerian degeneration and Schwann cells start to proliferate and produce a number of various growth factors such as nerve growth factor (NGF) [*Heumann, R., 1987*; *Thoenen H. et al., 1988*], ciliary neurotrophic factor (CNTF), brain-derived neurotrophic factors (BDNF) and NT-3, NT-4/5 and NT-5–6 [*Funakoshi H. et al., 1993; Lundborg G., 2004*]. Invading macrophages release interleukin-1, which triggers increased NGF transcription and NGF receptor density in the Schwann cells [*Taniuchi M. et al., 1986*; *Heumann R. et al., 1991*]. The existence of "preferential motor regeneration" under strict laboratory conditions has been stressed by T. Brushart and W. Seiler implying that motor fibres preferentially innervate distal motor Schwann cell tubes in contrast to distal sensory Schwann cells [*Brushart T. and Seiler W., 1987; Brushart T., 1988; 1990; 1993*]. The basis for this has been suggested to be the presence of specific "recognition molecules" in motor Schwann cell tubes as opposed to sensory Schwann cell tube [*Kunemund V. et al., 1988*]. However, according to Y. Maki and associates there is specificity in sensory regeneration but not in motor regeneration [*Maki Y. et al., 1996*]. According to Y. Maki, the outgrowth of Schwann cells in the distal nerve segment has an important role in this context. Although the issue of specificity in axonal regeneration is a crucial issue, opinions vary regarding the expression of specificity in experimental regeneration models. It is not known if, or to what extent, specificity mechanisms are active in clinical situations.

Despite improvements in treatment, the recovery after peripheral nerve injuries is not only often disappointing but also difficult to predict. For both patient and doctor, it is necessary to prognosticate the chances of recovery so that treatment expectations can be realistic and appropriate rehabilitation measures can be taken. In previous literature, a number of factors have been found to predict motor and sensory recovery after peripheral nerve injury. These include age, site, delay between injury and repair, and surgical technique. However, despite numerous published reports on peripheral nerve repair, there is no agreement on which variables are independent predictors of a successful prognosis, and the effect of the predictors is not quantified.

At present, a larger number of studies with detailed individual data are available [*Clarke M. et al., 1998*]. However, many of these publications were based on small patient numbers and, because of the wide range of patient and injury characteristics, different parameters were found to be of prognostic importance. Because of the considerable variety of factors influencing nerve regeneration and outcome, the final recovery after peripheral nerve injury is a complex matter. In numerous studies of the past decades, several variables have been proposed to influence outcome. Although several authors have proposed new assessment methods to evaluate functional recovery of the hand after nerve repair, no conclusive test battery is available. Recently, B. Rosén and G. Lundborg published a rationale for evaluation of functional recovery following nerve injuries [*Rosén B. and Lundborg G., 2000*]. The outcome is influenced by several factors that depend on mechanisms in the peripheral as well as the central nervous system. Adequate measures of sensory and motor function, separately and integrated, have to be de-

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fined and quantified [*Dellon A., 1981*; *Lundborg G., 1988*; *Lundborg G., Rosén B., 1994*]. A battery of tests that focuses on four key factors of the outcome has been described [*Rosén B., 1996*]: basic elements are the state of peripheral sensory and motor components as the basis of perception of tactile stimuli and of motor activity. Absence of pain or discomfort is also vital for hand function, and hyperaesthesia (and particularly cold intolerance) can be a great hindrance to more complex functions. Tactile gnosis is the complex sensibility that gives the grip sight, using both the hand and the brain — a function that is dependent on age as well as on cognitive capacity; and for active use of the hand both sensory and motor functions are integrated in function, which involves combinations of skin and various muscles and joints in coordinated actions.

There are several tests of this range of functions, and it is essential that we use instruments in our assessments that are reliable and valid [*Ewing-Fess E., 1986; Moberg E., 1991*]. Historically, the most commonly used scale for assessment of sensory and motor functions of the hand is the Medical Research Council scales [*Medical Research Council and Committee, 1954*].

In our center we also use the British Medical Research Council scale for both motor and sensory function testing as it is the most widely accepted classification to score the outcome of peripheral nerve injuries [*Allan H., 2000*]. In all hand centers it is very popular to use model instrument [*Rosén B. and Lundborg G., 2001*] for documentation of the outcome after nerve repair. The latter is available in our center as well. This includes assessment of the sensory, motor and pain/discomfort outcomes. Sensory outcome measurements are assessed by the pocket version of Semmes-Weinstein monofilaments which are used in the manner described by J. Bell-Krotoski [*Bell-Krotoski J., 1995*]. Tactile gnosis is assessed using both static two-point discrimination (s2PD) according E. Moberg [*Moberg E., 1990*] and the STI-test (Shape/Texture Identification test) [*Rosén B., Lanborg G., 1998*]. Finger dexterity is assessed with three parts of the C. Sollerman hand function tests [*Sollerman C., Ejeskär A., 1995*]. Grip strength is measured using Jamar dynamometer as described by V. Mathiowetz et al. [*Mathiowetz V. et al., 1985*]. Pain/discomfort outcome is assessed by asking patients to grade problems due to hyperaesthesia and cold intolerance on a 0-3 scale [*Rosén B., 1996*].

A group of surgeons and therapists came together in 1993 to review and define tools that could be used for outcome measurement after hand surgery. The group identified a need for development of questionnaires designed specifically for patients undergoing hand surgery. Nowadays there are several validated health-related quality of life (HRQL) measures based on the condition being studied [*Bindra R. et al, 2003*].

Disabilities of the arm, shoulder and hand (DASH) is a region-specific tool designed to measure outcome of musculoskeletal conditions affecting the upper limb [*Hudak P. et al., 1996*]. The advantages of DASH are sound development methodology and normative data that are available. DASH has been used for conditions of the hand, wrist, elbow, and shoulder. The drawbacks of the DASH are that it was designed to measure disability based on clinician input and cannot measure impairment, handicap, satisfaction or HRQL [*Bindra R. et al., 2003*].

Since the introduction of microsurgical techniques in the 1960s, the repair of peripheral nerve injuries has not changed considerably. Therefore, it seems not likely that the operation techniques have influenced our results. Although microsurgical nerve repair techniques have been refined to an optimal level, there is still a great extent of misorientation of regenerating axons at the repair site. It is known that experience of the surgeon plays an important role; however, it was not possible to consider this. Not all variables were known for every patient, so it was not possible to include all patients in the data analysis. However, the outcome from peripheral nerve surgery varies considerably among patients, even when conditions as well as surgical techniques are virtually identical.

Despite the use of microsurgical techniques for nerve repair, median, ulnar, or combined injuries lead to long-lasting disabilities in terms of fine sensory and motor functions. Moreover, pain and discomfort from hyperaesthesia, as well as cold intolerance can be very problematic with large impact on activities of daily living

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(ADL) [*Rosén B., 1996; Jaquet J.-B. et al., 2001; Carlsson I. et al., 2003*]. The individuals' ability to experience and interact with the surrounding world is thereby disturbed.

Clinical experience shows that the outcome of nerve repair in adults is often disappointing and far from satisfactory, especially with respect to recovery of tactile discrimination [*Wynn-Parry C., 1986*; *Moberg E., 1991*; *Jerosch-Herold C., 1993*; *Kallio P., Vastamaki M., 1993; Allan H., 2000*; *Rosén B., 2000*; *Lundborg G. and Rosén B., 2004*].

Several authors found a better motor recovery in median nerve injuries compared with ulnar nerve injuries [*Haase J. et al., 1980*; *Moneim M.,* 1982; *Tackmann W. et al., 1983; Amillo S. and Mora G., 1999*; *Rosén B. and Lundborg G., 2001*; *Kabak S. et al., 2002*] and no difference for sensory recovery [*Trumble T. et al., 1995*]. In ulnar nerve injuries, the chance of motor recovery was 71 percent lower than in median nerve injuries [*Ruijs A. et al., 2005*]. However, J.-B. Jaquet and co-authors revealed no statistical differences between median and ulnar nerve injuries [*Jaquet J.-B. et al., 2001*]. Combined median-ulnar nerve injuries can end in a much worse functional condition in comparison with single nerve injuries, clawing of all the fingers and a totally paralyzed hand [*Widgerow A., 1990*]. G. Chin and associates suggested that trauma of median, ulnar, or a combination determines overall functional outcome [*Chin G. et al., 1998*]. However, despite the functional impairment [*Rogers G. et al., 1990*], scarce data is available on the extent to which the combined median-ulnar nerve injuries have a different prognosis.

There are significant prognostic factors influencing the outcome for motor and sensory recovery. For motor recovery: age, delay, site, and type of injured nerve were found to predict outcome; for sensory recovery: age and delay were significant prognostic factors. Younger patients were more likely to have a satisfactory motor and sensory outcome and the longer the delay between injury and repair, the smaller the chance of a favorable outcome. Combined median and ulnar nerve injuries and the use of autologous nerve grafts did not significantly predict motor recovery. It appears that the combined median and ulnar nerve injuries have worse prospects concerning sensory recovery compared with the single nerve injuries. Perhaps, the larger area in the somatosensory cortex, which needs to be reorganized, can explain this finding [*Jaquet J.-B. et al., 2005*]. There was no significant difference between median and ulnar nerve injuries in relation to sensory recovery [*Ruijs A. et al., 2005*]. From the previous research, several factors have been pointed out to influence final recovery. In general, age was found to be a main factor for recovery [*Sakellarides H., 1962*; *Simesen K. et al., 1980*; *Gaul J., 1982; Stellini L., 1982*; *Puckett C. and Meyer V., 1985*; *Marsh D. and Barton N., 1987*; *Jongen S. and Van Twisk R., 1988*; *Tajima T. and Imai H., 1989*; *Barrios C. et al., 1990*; *Barrios C. and de Pablos J., 1991; Rogers G. et al., 1990; Jerosch- Herold C., 1993*; *Amillo S. and Mora G., 1999*]. This can be explained by factors like shorter regeneration distance and greater regeneration potential, but recent research in primates shows also that in children there is probably a higher potential for brain plasticity compared with adults [*Lundborg G., 2000a; 2000b*]. Some authors mentioned that especially sensory recovery benefits from a younger age [*Rosén B. and Lundborg G., 2001*] and this is often explained by better capacity of children to adapt to reorganization of central nervous system that follows nerve repair [*Almquist E. et al., 1983*; *Florence S. et al., 1996*; *Hudson D. et al., 1997*; *Lundborg G., 2000a*].

After nerve transection there is an initial delay followed by sprouting and axonal outgrowth. A nerve outgrowth rate of at most 1–2 *mm/day* in humans has been suggested [*Buchthal F. and Kühl V., 1979*]. In digital nerve injuries there is only a short distance separating the regenerating axons from their distal targets, while injuries at the upper arm level create different situations with longer time before reinnervation of the hand occurs. Median nerve lesions at the wrist level may require 3-4 months before the first signs of reinnervation. Following nerve repair at the distal forearm level of major nerve trunks, the fingers may be without sensibility for up to 6 months before reinnervation at the finger level occurs. Using the diagnose specific outcome instrument Model Instrument for Outcome after Nerve Repair [*Rosén B. and Lundborg G., 2001*],

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a reference interval for the outcome with the estimated 95% predicted values for the outcome shows ongoing improvements up to 5 years after the nerve repair.

The site of injury has been mentioned as the most important determinant of outcome [*Gaul J., 1982*]. By conclusion of some authors, it is a significant predictor only for motor recovery [*Ruijs A. et al., 2005*]. A muscle can become atrophic and irreversibly damaged in 1.5 to 2 years. As it was said nerve regeneration occurs with a speed of approximately 1 *mm* per day, and if not restored in the meanwhile, motor recovery will be poor [*Ehni B., 1991*].

The type of injury is also one of the predictors of outcome. A crushed lesion always results in better functional outcome when compared with total severance of a nerve trunk [*Lundborg G., 2004*]. The initial delay is shorter and the growth of axons proceeds at a faster rate after a crush injury when compared with a nerve transection. The Schwann cell basal lamina is still in continuity and can thus guide the axons back to their original peripheral targets. The correct peripheral reinnervation of the crush injuries are reflected in a perfect restoration of the original cortical representational areas corresponding to the reinnervated body part [*Merzenich M. and Jenkins W., 1993*].

The results of many studies confirm that a delay is also associated with the outcome. An unfavorable prognosis was found after more than 6 or 12 months delay [*Sakellarides H., 1962; Stellini L., 1982*; *Marsh D. and Barton N., 1987*; *Jongen S. and Van Twisk R., 1988*; *Barrios C. et al., 1990; Marsh D., 1990; Barrios C. and de Pablos J., 1991; Daoutis N. et al., 1994; Trumble T. et al., 1995; Amillo S. and Mora G., 1999*; *Kabak S. et al., 2002*]. Others advocated the use of an early secondary repair for all injuries [*Van Dulke H. and Thomeer R., 1978*]. M. Merle and co-workers found, in a small group of patients, a higher percentage of failures after nerve repair performed on an emergency basis than after secondary repair [*Merle M. et al., 1986*]. After grouping the delay period into primary repair (0 days delay), delayed primary repair (1 day to 1 month), early secondary repair (1 to 3 months), and secondary repair (3 to 6 months, 6 to 12 months, and more than 1 year delay), there seemed to be a tendency for the early secondary repair (1 to 3 months) to achieve slightly better results (odds ratio, 4.66; 95 percent confidence interval, 0.81 to 26.83) compared with delayed primary repair (1 day to 1 month: odds ratio, 2.38; 95 percent confidence interval, 0.58 to 9.82) and no delay (0 days, reference group), although this was not significant (p=0.08) [*Ruijs A. et al., 2005*].

As shown in earlier studies [*Millesi H. et al., 1972; 1976*; *Walton R. and Finseth F., 1977; Simesen K. et al., 1980; Frykman G. and Cally D., 1988*], there is no difference between direct repair and interfascicular grafting. It has been noticed that long grafts are more likely to give unfavorable results [*Haase J. et al., 1980*; *Barrios C. et al., 1990*; *Barrios C. and de Pablos J., 1991; Amillo S. and Mora G., 1999*]. C. Barrios and associates did not find a better outcome in children after nerve grafting [*Barrios C. et al., 1990*].

Although some excellent reviews have been published on nerve grafting [*Mackinnon S. and Dellon A., 1988; Vanderhooft E., 2000*], only G. Frykman and K. Gramyk performed a meta-analysis [*Frykman G. and Gramyk K., 1991*]. In 114 median nerve injuries and 98 ulnar nerve injuries, it was found that type of nerve, age, gap length, and level of injury affected the outcome.

Nerve injuries may seriously interfere with an individual's capacity to function adequately, and the disability acquired is often dramatic: a hand without sensibility is usually a hand without function. Most frequently, nerve injuries are seen in the upper extremity of young males [*McAllister R. et al., 1996; Noble J. et al., 1998*], as there is a high probability of work loss [*Jaquet J.-B. et al., 2001*] and the quality of life of the patient may be greatly impaired. Lifelong hand function impairment, pain, dysaesthesia and cold intolerance are frequent. There is also a substantial economic impact of nerve injuries on the patient, as well as on society.

The return to productivity is becoming an issue of growing national concern for economic reasons [*Tate D., 1992*]. Many studies reported on return to work following trauma or illness [*Smith M. et al., 1985; Rogers G. et al., 1990; Morris J. et al., 1991*; *Tate D., 1992*; *Brenneman F. et al., 1997; Taha A. and Taha J., 1998*]. Despite the suggestion that extremity injuries dis-

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proportionately contribute to long-term disability [*Smith M. et al., 1985; Morris J. et al., 1991*; *Tate D., 1992*; *Brenneman F. et al., 1997; Taha A. and Taha J., 1998*], the return to productivity has been underexposed in previous studies on spaghetti wrist injuries. G. Rogers and co-workers [*Rogers G. et al., 1990*] reported an 87.5 percent return-to-work ratio among patients with combined median and ulnar nerve injuries. A. Taha and J. Taha reported a 0 percent return-to-work ratio among patients with combined median and ulnar nerve injury following missile injuries [*Taha A. and Taha J., 1998*]. Both studies reported small numbers of patients (eight and seven patients, respectively). In their study J.-B Jaquet and associates revealed that 45.2 percent of employed patients did not return to work within 1 year following the injury [*Jaquet J.-B. et al., 2005*]. The ability to restart work was found to be associated with motor and sensory recovery. Surprisingly, despite differences in motor recovery, the ability to restart work did not differ between single and combined nerve injuries. Studies that focused on factors associated with delayed return to work concluded that correlation between physical impairment and the rate of return to work is weak [*Crook J. et al., 1998; MacKenzie E. et al., 1998*]. Furthermore, it has been stated that severity of the injury does not predict return to productivity [*Morris J. et al., 1991*]. On the other hand, the relationship between motor recovery and regeneration time suggests that time off work will vary between the different groups. Prospective extension is needed to obtain information that is more precise on socioeconomic losses in terms of lost workdays and restricted work activity.

Outcome studies on functional recovery have shown that occupational therapy plays a major role in the recovery and rehabilitation of patients with forearm nerve injury [*Puckett C. and Meyer V., 1985*; *MacKenzie E. et al., 1987*]. Reeducation of sensory function was found to have a positive influence on functional results [*Parry C., Salter M., 1976*]. With sensory reeducation adults can, to some extent, use the plasticity of the brain to learn to interpret the new pattern of the sensory cortex representation when touching different objects [*Parry C., Salter M., 1976; Jenkins W. et al., 1990; Imai W. et al., 1991; Dellon A., 1997*].

In addition to the large number of peripheral and central factors, active and conscious use of the hand in activities of daily life, combined with high motivation by the patient, is since long reported to be a factor of great importance for useful return of functional sensibility [*Callahan A., 1995*]. C. Bruyns and co-workers found that high education, high compliance to hand therapy and an isolated injury predict quicker return to work in patients with median and/or ulnar nerve injuries [*Bruyns C. et al., 2003*].

The surgeon's ambition is to use repair techniques bringing a maximal number of nerve fibres into peripheral cutaneous territories. However, there are at least three strong indications that central nervous factors associated with cortical re-modelling represent a major reason for the inferior functional outcome following nerve repair:

1. children up to the age of 10-12 years usually present excellent recovery of functional sensibility in contrast to adult patients. This critical "age-window" for perfect sensory recovery presented by children corresponds well to what is known from other types of learning processes, for instance the ability for acquisition of a second language [*Rosén B. and Lundborg G., 2001*];
2. cognitive functions are important explanatory factors in adults for variations in recovery of tactile discrimination [*Rosén B. et al., 1994*; *Jaquet J.-B., 2004*];
3. the peripheral repair technique in median nerve lesions has not been found to influence the functional outcome in a clinical randomized study at a 5-year follow-up [*Lundborg G. et al., 2004*].

Silicone tubular repair leaving a short distance between the nerve cuts was compared with the outcome from routine microsurgical repair in a clinical randomized prospective study comprising 30 patients with median or ulnar nerve injuries in the distal forearm. Postoperatively, the patients were assessed regularly over a 5-year period with neurophysiological and clinical assessments. After 5 years, there was no significant difference in outcome between the two techniques except that cold intolerance was sig-

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nificantly less severe with the tubular technique. The most significant improvement of perception of touch occurred during the first postoperative year, while improvement of motor function could be observed much later [*Rosén B., 2000*]. However, the functional sensibility in the total group was reported to improve through the 5 years after repair, although there was no further impairment in nerve conduction velocity or amplitude after the first 2 years [*Lundborg G., 2004*]. This supports the fact that the central nervous factors associated with the cortical remodelling after a nerve repair are important, and that efforts to improve the results from nerve repair in future must address the brain as well as the peripheral nerve.

Throughout history, the hand has been identified as an important component of human anatomy, unique in structure and function [*Haese J., 1985*]. Because the hand is frequently used as a nonverbal medium of communication, a disfigured hand results in negative changes in self-image [*Grunert B. et al., 1988*]. Earlier studies reported on psychological problems following severe hand trauma [*Haese J., 1985; Grunert B. et al., 1988*]. B. Grunert and associates found that 94 percent of patients with severe hand injury experienced psychological symptoms at some point early in rehabilitation [*Grunert B. et al., 1988*]. T. Richmond and coworkers reported a mean Impact of Event Scale score of 30.6 among patients 3 months after a noncentral nervous system trauma [*Richmond T. et al., 1998*].

Predictors for intensity of posttraumatic psychological stress following median and ulnar nerve injuries are number of severed structures, combined versus single nerve injuries, and sex. Education was found to be a protecting variable [*Jaquet J.-B. et al., 2002*]. There were limitations to this part of the study. Retrospective data collection will tend to underestimate the amount of psychological stress. Patients may have failed to recall their reaction to their traumatic nerve injury. On the other hand, patients with worse functional outcome and reduced capacity for work may tend to exaggerate severity of psychological stress. Despite these limitations, it can be concluded that the early psychological consequences of spaghetti wrist injury are not to be underestimated. During follow-up, on average 10 years postoperatively, spaghetti wrist patients reported a statistical decrease of the Impact of Event Scale score. Early recognition and treatment of patients who are at great risk to develop a posttraumatic stress disorder may influence the functional outcome. Results on the clinical utility of the scale showed that it has sufficient reliability and validity to warrant its use as a clinical screening method for traumatic stress [*Zilberg N. et al., 1982; Briere J. and Elliott D., 1998*].

One of the principal clinical problems after a nerve injury is the uncertainty concerning functional recovery. Reinnervation after nerve injuries at the wrist and forearm levels is often incomplete and causes a long period of suspense. Despite an enormous amount of new data and evolving new scientific concepts, nerve injuries are still one of the most challenging and difficult surgical reconstructive problems. Today there is no surgical technique, which can ensure recovery of tactile discrimination in the hand of an adult after a median nerve lesion. Thus, considering the impact of nerve injuries on quality of life as well as working capacity and economy there are good reasons to re-evaluate and revise some of the current principles of nerve repair [*Lundborg G., Rosén B., 2007*].

Many different reporting methods, scoring systems, and evaluation techniques are being used to quantify sensory and motor recovery after upper extremity nerve injuries [*Rosén B., 1996*]. The comparison with earlier contributions dealing with functional outcome [*Posch J. and Cruz-Saddul F., 1980; Merle M. et al., 1986; Mackinnon S. and Dellon A., 1988; Kallio P. and Vastamaki M., 1993; Vastamaki M. et al., 1993; Noble J. et al., 1998*] is therefore difficult.

Despite numerous studies all over the world, to our knowledge, no published retrospective or prospective studies are available in Armenia. Because of variable results in different existing trials, recently the study was initiated in our center using the extended test battery besides motor and sensory testing, such as activities of daily living, quality of life, cold intolerance, and psychosocial factors, which could give better insight into the outcome of peripheral nerve repair and regeneration.

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