



## Microsurgery and Repair of Peripheral Nerve Injury

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### Letter to Editor

Peripheral nerve injury is a common complication. The rate of peripheral nerve is assessed between 13 and 23 per 100,000 persons per year injuries in developed countries [1]. In situations that clinical and electrophysiological signs did not show recovery, microscopic surgery is preferred to rebuild the environment has revolutionized the engineering environment of the nerve tissue [2]. In this regard and depend on the necessity, primary repair, and nerve grafting or tubulization techniques, without undue tension, can be performed. Nerve auto grafting is current gold standard for bridging nerve gaps. This method has some disadvantages, such as donor site morbidity and limited length of available graft material. So, scientists tried to search for alternative means of nerve gap reconstruction. For repair of wide nerve injuries nerve allografting is suggested. For bridging short nerve defects, tubulization techniques with natural or artificial conduits are introduced. This alternative method does not involved harvesting of autologous nerve grafts and also does not concomitant with the morbidity. Therefore, new advancements in the field of microsurgical techniques with aid of biology in accompany with engineering helps the clinicians and society. The field of peripheral nerve research is dynamically increasing and deliberates on more effective methodologies experienced at the level of basic science. Future discoveries in peripheral nerve restoration for nerve allografting includes induction of tolerance and minimum using of immunosuppression, cell based- assisted therapies and bioengineering of nerve conduits. Immunosuppression is performed by using azathioprine, prednisone, cyclosporine A, cold-preservation of allografts and tacrolimus were reported to result in inhibition of host rejection response in nerve all transplantation improved functional recovery and axonal regeneration [3]. Combination of cold-preservation with either cyclosporine A or tacrolimus showed better results than single therapy. Selective and nonselective T-cell elimination improve nerve allograft and induce tolerance. The latter include use of polyclonal antibodies—poly Anti-Lymphocyte Globulin (ALG) and Anti Thymocyte Globulin (ATG)—and monoclonal antibodies—anti-CD3 (muromonab) and anti-CD52 Campath-1H Campath<sup>®</sup> (alemtuzumab) (Genzyme Corporation, Cambridge, MA) are used in clinical practice. In rat nerve allograft models 5 week selective T-cell depletion regimen (alfabeta T-cell receptor monoclonal antibody supported with CsA) Host's pretreatment with donor antigens and single intra portal injection of ultraviolet-B irradiated splenocytes are two approaches that were introduced to induce tolerance [4].

When surgery is required, it should be keep in mind that the primary goal of nerve repair and regeneration is to allow reinnervation of the target organs by guiding regenerating sensory, motor, and autonomic axons into the target of the distal nerve with minimal loss of fibers at the suture line [5]. Type, location, and extent of nerve injury; timing of surgery; type of repair; proper alignment of fascicles; surgical technique; and patient comorbidities are important factors that should be noticed for repair of peripheral nerve injury [6]. Extensive experimental researches to develop skills that lead to satisfied outcome in clinical practice are not achieved yet. Nerve tissue injury can be in accompanied with tissue loss or not. In clean transection or without tissue loss, direct repair consist of end-to-end repair, epineural sleeve neuroorrhaphy and end-to-side repair are decided upon the necessity. In small gap or without tissue loss situation, the proximal cut end can be available for repair or not. The former can be repaired by End-to-End suture which includes epineurial, fascicular and group fascicular suturing and the later can be repaired by End-to-side repair or neurotization / nerve transfer. In nerve transfer the distance to target organ which has to regenerate is minimized [7].

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The main method or "golden standard" for repairing nerve repair is auto graft. Defects based on length are divided to less than 3 cm (small gap) or larger. The former can be repaired by conduits or guide tubes including natural or artificial ones. The latter, the massive nerve tissue loss and the biggest surgical challenge in peripheral nerve surgery, can be repair by allografting. Allografts are non-processed cadaver nerve grafts which obtained in long distances which require multiple long nerve grafts. Disadvantage of allografting method is rejection and complaints about immunosuppressing [8].

Many improvements have been made to microscopic surgery techniques, such as the use of adhesive materials (glue) instead of suturing which resulted in a higher level outcome than the epineurial or fascicular and group fascicular suturing. The use of robots in microscopic surgeries is another example of progress. Optogenetics which involves the use of light to control cells in living is a novel therapy for peripheral nerve injuries [9]. Genetically modified neural cells and expressing light-activated proteins are activated and inactivated by specific wavelengths of light. In this method precise control of neural activation and inhibition without the need for physical contact with the nerve is a novel technology for peripheral nerves [10].

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