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Neuromuscular Electrical Stimulation and Hand Rehabilitation Following Median Nerve and Radial Artery Injury in a Pediatric Patient: A Case Report

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Abstract

Median nerve injuries in pediatric patients represent a significant challenge due to their impact on hand function and fine motor development. This case report presents the rehabilitation outcomes of a seven-year-old child who sustained a traumatic injury involving the flexor pollicislongus and flexor carpi radialis muscles with associated radial artery injury and median nerve lesion. The patient underwent a structured physiotherapy program including neuromuscular electrical stimulation and task-oriented hand exercises over six weeks. Electrodiagnostic evaluation before treatment revealed severe denervation of the recurrent thenar motor branch of the median nerve. Follow-up electrodiagnostic findings after rehabilitation demonstrated improvement in motor nerve parameters which correlated with marked functional recovery. This case highlights the potential effectiveness of neuromuscular electrical stimulation combined with functional hand training in pediatric peripheral nerve injuries.

Keywords: Neuromuscular electrical stimulation (NMES); Functional electrical stimulation (FES); Hand rehabilitation; Occupational therapy; Physical therapy; Sensory re-education; Splinting and orthotics; Motor re-learning

Introduction

Traumatic median nerve injuries in children can result in profound impairment of hand function particularly affecting thumb opposition grasp strength and fine motor skills. Early physiotherapy intervention is essential to minimize muscle atrophy facilitate neural recovery and promote functional independence. Neuromuscular electrical stimulation has been utilized as an adjunctive modality to enhance neuromuscular activation improve circulation and support reinnervation following peripheral nerve injury. However limited evidence exists regarding its use in pediatric populations. This case report aims to describe the clinical and electrodiagnostic outcomes of neuromuscular electrical stimulation combined with functional hand rehabilitation in a pediatric patient with median nerve injury.

Case Presentation

A seven-year-old child presented following a traumatic forearm injury resulting in damage to the flexor pollicislongus and flexor carpi radialis muscles with associated radial artery injury and median nerve involvement. Clinical examination revealed significant weakness of thumb flexion impaired grasp function and difficulty performing age-appropriate fine motor activities. Functional use of the affected hand was markedly limited during daily activities and play.

Electrodiagnostic Assessment

Electromyography and nerve conduction studies were performed prior to initiation of physiotherapy to assess the severity of neural involvement. Motor nerve conduction study of the



Figure 1: Stimpower device.

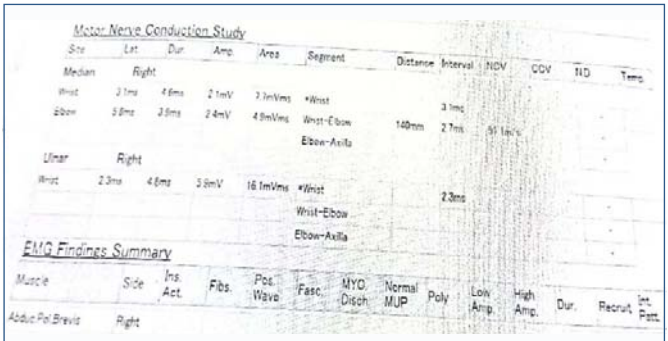


Figure 2: Pre physical therapy EMG diagnosis.

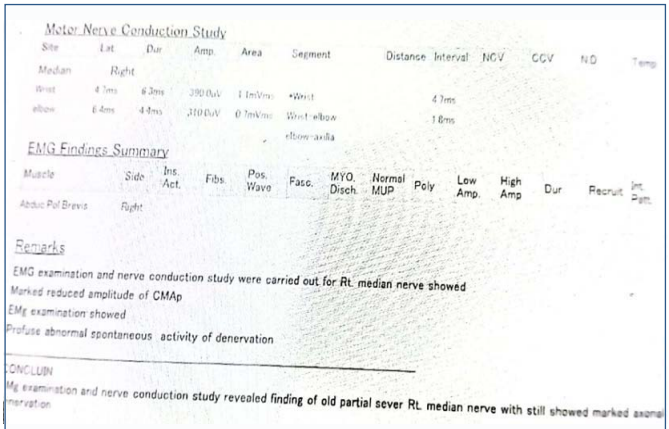


Figure 3: Post physical therapy EMG diagnosis.

right median nerve demonstrated markedly reduced compound muscle action potential amplitude indicating significant axonal injury. Electromyographic examination revealed profuse abnormal spontaneous activity consistent with severe denervation particularly involving the recurrent thenar motor branch supplying the abductor pollicis brevis muscle. These findings were consistent with an old partial severe right median nerve lesion with ongoing denervation changes.

Intervention

The patient participated in a comprehensive physiotherapy program consisting of eighteen sessions conducted over a six-week period. Neuromuscular electrical stimulation was applied for twenty minutes per session to the affected hand muscles using the Stimpower Indian device. Stimulation parameters were selected to facilitate muscle contraction and neuromuscular re-education while maintaining patient comfort and safety.

In addition to neuromuscular electrical stimulation the rehabilitation program incorporated therapeutic hand exercises emphasizing fine motor control and functional use. Activities included nerve stimulation ball exercises cube manipulation and play-based tasks designed to enhance dexterity coordination and precision. All activities were developmentally appropriate to promote engagement and active participation.

Results

Outcomes and Follow-Up Electrodiagnostic Findings

Throughout the rehabilitation period the patient demonstrated progressive clinical improvement. Observable gains were noted in thumb movement grasp ability and performance of fine motor tasks. Functional use of the hand during play activities improved markedly compared to baseline.

A follow-up electromyography and nerve conduction study was performed after completion of the physiotherapy program for reevaluation. Post-treatment findings demonstrated improvement in motor nerve conduction parameters of the right median nerve with increased compound muscle action potential amplitude compared to pre-treatment values. Electromyographic examination showed a reduction in abnormal spontaneous denervation activity with emerging signs of neuromuscular recovery. These electrodiagnostic improvements were consistent with the observed clinical and functional gains.

Discussion

This case report demonstrates that neuromuscular electrical stimulation combined with functional hand rehabilitation may contribute to meaningful recovery in pediatric patients with median nerve injury. Despite initial electrodiagnostic evidence of severe denervation the patient exhibited significant functional and electrophysiological improvement over a relatively short rehabilitation period. The use of task-oriented play-based exercises likely enhanced motor learning and neural plasticity which is particularly relevant in pediatric rehabilitation. Early structured physiotherapy intervention appears to play a critical role in optimizing outcomes following peripheral nerve injuries in children.

Conclusion

Neuromuscular electrical stimulation combined with functional hand rehabilitation exercises may be an effective therapeutic approach for pediatric median nerve injuries. This case highlights the importance of early intervention and the integration of electrophysical modalities with task-specific training to enhance functional and neural recovery. Further studies with larger samples and long-term follow-up are recommended to support these findings.