



## RESEARCH ARTICLE

# EFFICACY OF ELECTRICAL STIMULATION ALONG WITH THERAPIST ASSISTED SENSORY MOTOR TASK TRAINING (TASTT) IN WRIST DROP SECONDARY TO POST TRAUMATIC SOFT TISSUE INJURY- A CASE REPORT

\*Ranjeet Singh, Narkeesh Arumugam and Shefali Gambhir

Department of Physiotherapy, Punjabi University, Patiala

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### ABSTRACT

This paper reports the benefits of therapist assisted sensorimotor task specific training (TASTT) and electrical stimulation in the rehabilitation of Wrist drop. Wrist drop is caused by damage to the radial nerve, which travels down the arm and controls the movement of the triceps muscle at the back of the upper arm, because of several conditions. An intervention of 20 days (5 days per week for 4 weeks) was given to the patient & prognosis was observed on various outcome variables like Chedoke arm and hand inventory scale and strength and duration (SD) curve before & after the intervention. A poor prognosis was seen in both the variables which may be because of Neurolysis.

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## INTRODUCTION

Wrist drop is caused by damage to the radial nerve, which travels down the arm and controls the movement of the triceps muscle at the back of the upper arm, because of several conditions. This nerve controls the backward bend of wrists and helps with the movement and sensation of the wrist and fingers (Han *et al.*, 2014). Unlike patients with median or ulnar nerve palsy, in whom sensory and intrinsic muscle loss impedes hand function, the patient with radial palsy has the potential for relatively normal use of the hand (Colditz, 1987). The primary functional loss in radial palsy is inability to stabilize the wrist in extension so that the finger flexors can be used normally. The loss of the wrist and finger extensors destroys the essential reciprocal tenodesis action vital to the normal grasp-and-release pattern of the hand (Colditz, 1987; Chan, 2002). Nerve injuries are often examined by electrophysiologic studies, including nerve conduction studies (NCS) and clinical electromyography, to determine the location, extension and duration of the lesion. Physical therapists may have a limited role in directly treating the nerve injury during the early stages after nerve injury or repair. Full recovery of function will only occur with time, specifically

with reinnervation of the muscles and sensory end organs. Instead, during these early stages physical therapists should address prevention of deformity and stiffness, protection from falling or from further damage to the limb or nerve, preservation of existing function, and pain management (Armentrout, 2012). Specific types of physical therapy interventions depend on the time course of the nerve injury. For example, bracing or splinting for protection may be needed early in the course of the nerve injury. Therapeutic exercise and sensory re-education may be used later as the injured nerve recovers. One physical therapist may not possess all of the skills necessary to perform all aspects of examination, evaluation, diagnosis, prognosis, and intervention. The prudent physical therapist must recognize when to refer or to consult with other physical therapists and health care practitioners in order to provide timely and optimal management. This includes recognition of when a referral to a surgical specialist is indicated based on the examination/ evaluation, lack of improvement after intervention, or when the diagnosis is in question (Armentrout Elaine, 2012). Neuromuscular electrical stimulation (NMES) targets muscle tissue through an intact peripheral nervous system. Neuromuscular electrical stimulation can strengthen healthy muscle. However, voluntary exercise alone develops the same or more strength than voluntary exercise combined with NMES. Denervated muscle can also be stimulated through NMES, although muscle

\*Corresponding author: Ranjeet Singh

Department of Physiotherapy, Punjabi University, Patiala

atrophy can only be slowed and not prevented. There are contradictory findings and no consensus regarding the efficacy, deleteriousness, cost benefit, and patient compliance issues of this method of intervention for denervated muscle. Similar to biofeedback, once active muscle contraction occurs, the patient is progressed to other forms of exercise (Armentrout Elaine, 2012).

e.g. if patient have left side effected tie your right hand so that therapist ventral aspect of hand faced dorsal aspect of patient hand). After tying the micropore with all fingers and thumb at the DIP and PIP joint, the therapist assist and direct all the movements of finger and thumb including the flexion and extension at PIP, DIP and MCP joint, abduction and adduction at MCP joint , opposition and wrist flexion, extension and



**Fig. 1. Palmar Adduction and Abduction**



**Fig. 2. Finger Extension**

A new approach (Therapist assisted sensori-motor training {TASTT}) based on the principles of neuroplasticity, learned non use phenomenon and somatosensory input is invented through this case study which signifies patterned neural activity in regeneration and recovery of function. The primary novelty of this case report is the demonstration of substantial gain of functional independence in daily living in context of hand functions after wrist drop. This case report aims to evaluate the effectiveness of TASTT to improve the symptoms of wrist drop secondary to soft tissue injury.

### **Description of TASTT**

This approach was designed by integrating the principles of learned non-use phenomenon, mirror neurons, neuroplasticity and somatosensory input (gambhir and Arumugam, 2016).

**Material used-** Micropore tape and Glove

**Procedure:** The therapist fastening his hand including finger and thumb with patient hand with the help of micropore (for

radial and ulnar deviation. These will give visual feedback to the patient as he/she is moving his own independently. This is helpful in preventing associated movements and directing and learning each movement of hand separately (gambhir and Arumugam, 2016). (Therapist can also wear a glove to hidden his support in doing movement. Glove should be of large sized so that both therapist and patient hand will be enclosed in it.).

### **Case Report**

A 15 years old male patient complains unable to lift his right wrist and hand up since 5 years. Patient was taking a regular physiotherapy treatment since 4 years but didn't see any improvement in the condition. Also, he was able to write with his right hand and do daily activities independently without facing any difficulty. Patient had met with a road traffic accident 5 years ago, he has fallen on road from auto rickshaw on his right side of the body. On the site of accident, the lateral aspect of right lower arm and upper forearm suffered from extensive soft tissue damage with heavily bleeding. Then, he was immediately taken to Rajindra hospital, Patiala from the

site of injury and x ray was taken by the doctor but no history of fracture was seen. After that, suturing of skin and soft tissues was done and he was admitted for next three days to prevent from spreading of infection.

was taking physiotherapy from 4 years with a gap of many months in between. He is a student & able to attend classes & able to drive two wheeler. He is able to perform ADLs independently except some difficulty in combing, holding a

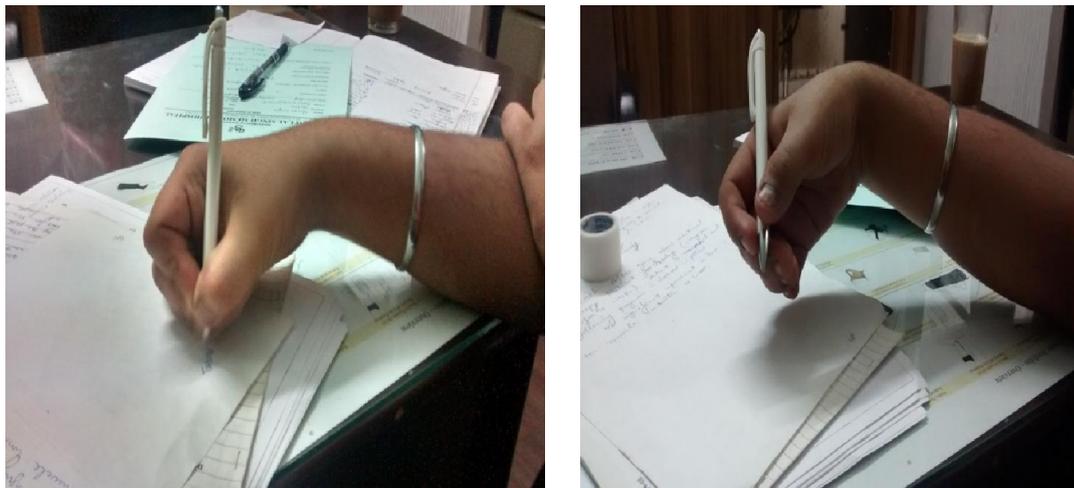


Fig. 3. Attitude of the limb (Wrist Drop)



Fig. 4. Keloid Scarring on Anterolateral aspect of lower arm and upper forearm

Table 1. Sensory examination of Right upper limb checked at dermatomal level

Dermatomes	Touch	Pain	Temperature	Sensibility Grading
C5 Lateral Shoulder	Grade 2	Grade 2	Grade 2	S4
C6 Tip of Thumb	Grade 1	Grade 1	Grade 1	S3
C7 Tip of Middle finger	Grade 1	Grade 1	Grade 1	S3
C8 Tip of Little finger	Grade 2	Grade 2	Grade 2	S3
T1 Medial Aspect of lower arm	Grade 2	Grade 2	Grade 2	S3

His parents notice that the patient was unable to move his finger and wrist up and unable to feel the touch sensation of the dorsum aspect of arm and forearm. After discharge, he was taken by his parents to P.G.I hospital Chandigarh for further evaluation and various diagnostic tests were performed. A Nerve conduction studies shows that there was absent motor and sensory response on right radial nerve stimulation and electromyography shows that right extensor carpi radialis, extensor digitorum communis, ext. pollicis longus muscles were atrophied but brachioradialis muscle was spared. The doctors advised him to take physiotherapy treatment and use cock up splint to prevent the development of deformity. The doctor's also said the patient parents that there was a little chance or poor recovery in this case. After few months, the patient feels touch sensations, hot and cold in the dorsum aspect of wrist and hand as said by the patient parents. Patient

glass of water, sharpening of pencil, closing the button. Patient is only son of his parents and belongs to middle class family. Family members were cooperative & supported in the treatment of patient and parents were worried about his difficulty. (The source of history was patient himself and his mother & medical history was recorded from the investigatory reports carried by him.) A signed consent for the present case report is obtained from the patient concerned. On Observation, built was mesomorphic and the wrist hand was in drooped position and no assistive device was used by the patient. A keloid type of scarring was seen in the antero-lateral aspect of lower arm and upper forearm of right side. Also patient was not using a splint as advised by a doctor and seems careless about his condition. On Examination, the higher mental functions was assessed by Mini Mental Status Examination (MMSE) & the patient score 30/30.

**Table 2. Active and Passive ROM Assessment of Right Upper Limb by using Goniometer**

Active	Joint & movement & normal ROM	Passive
Elbow joint		
0-130°	Flexion ( 0-150°)	0-140°
130°-0°	Extension (150-0°)	140°-0°
Wrist joint		
0° -70°	Flexion (0-80°)	0° - 80°
70°-0°	Extension ( 0-70°)	80°-0°
Finger joint		
0°-5°	MP flexion ( 0 to 90 °)	0°-70°
0°-5°	MP extension( 0to 90°)	0°-45°
5°-0°	Abduction (0to 20°)	0°-20°
0°-50°	Adduction (20 to 0)	30°-0°
0°-45°	PIP flexion( 0 to 100°)	0°-90°
	DIP flexion ( 0 to 90 °)	0°-90°
Thumb joint		
0°-30°	IP flexion( 0 to 50 °)	0°-45°
0°-30°	MP flexion ( 0 to 80 °)	0°-45°
5°-0°	IP extension (50 to 0°)	0°-45°
5°-0°	MP extension(50 to 0 °)	0°-45°
0°-5°	Abduction( 0 to 70°)	0°-70°
5°-0°	Adduction( 70 to 0 °)	70°-0°

**Table 3. Assessment of Muscle Strength of Upper Limb by using mMRC scale**

Left	Joint & movement	Right
Elbow joint		
5	Flexors (biceps & brachioradialis)	5
5	Extensors (triceps)	5
Forearm		
5	Supinator, biceps brachii short head, long head	4
5	Pronator teres, pronator quadratus	3-4
Finger		
5	MP flexor [Lumbricales, dorsal interossei, palmar interossei]	4-5
5	PIP flexor [flexor digitorum superficialis (2 heads)]	4
5	DIP flexor [flexor digitorum profundus]	4
5	MP extensor [Extensor digitorum, extensor indicis, extensor digiti minimi]	0
5	Abduction [Dorsal interossei (abductor indicis), abductor digiti minimi]	2
Thumb		
5	IP flexor [Flexor pollicis longus]	
	IP extensor [Extensor pollicis longus]	
5	MP flexor [Flexor pollicis brevis (sup and deep head)]	4-5
5	MP extensor [Extensor pollicis brevis]	0
	Abductor [Abductor pollicis longus and brevis]	
5	Adductor [Adductor pollicis ( both heads)]	4
5	Opposition (thumb to little finger) [opponens pollicis, opponens digiti minimi]	0
5		1
5		4
5		3-4

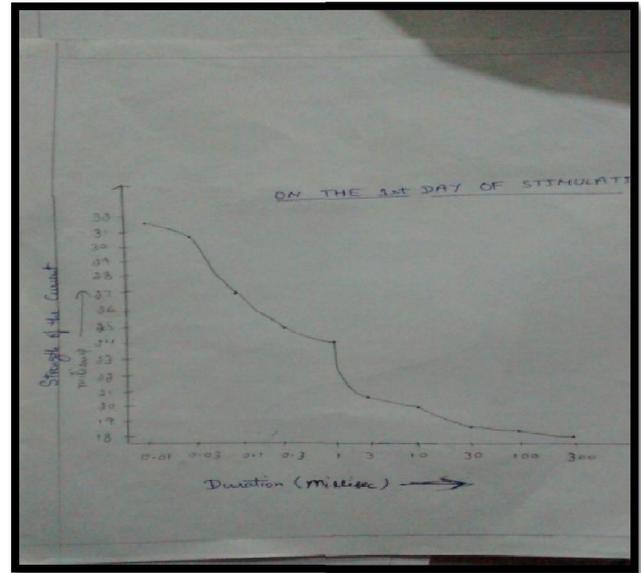
To examine the muscle wasting on the effected side, the muscle girth of both upper limb was assessed and compared by using Lacote method as described in Table 4. The deep tendon reflex examination was done which was described in table 5 below. The superficial sensations like touch, pin prick and temperature were checked at the dermatomal level (C4, C5, C6, C7, C8, T1, and T2) on right side as described in table below. On sensory testing, C6, C7 dermatomes [dorsolateral area of right hand and 1st three digits] was still having impaired or less sensation as compared to normal side. On motor examination, muscle tone in the extensor compartment of the wrist muscles was flaccid in nature or hypotonicity was seen. The tone of flexors or intrinsic musculature of the wrist and hand musculature was normal. The Range of Motion and Muscle strength was assessed by using goniometer and modified Medical Research Council [mMRC] scale as described above-

**Table 4. Comparison of Muscle girth assessed by lacote method**

Left	From olecranon process	Right
	Above (arm)	
24.1 cm	6 cm (biceps)	24.9 cm
25.2 cm	9 cm (long head of biceps)	26 cm
26.7 cm	12 cm (triceps)	27.1 cm
	Below (forearm)	
24.2 cm	3 cm	25.1 cm
24.9 cm	6 cm	25.6 cm
24.5 cm	9 cm	25.3 cm

**Table 5. Deep tendon reflex examination of right upper limb**

DEEP TENDON REFLEX	GRADE
Biceps brachii (C5, C6)	Grade 2
Triceps brachii (C7, C8)	Grade 2
Brachioradialis (C5, C6)	Grade 2

**Graph 1. Strength Duration Curve of Extensor Digitorum before the administration of intervention**

To examine the muscle wasting on the effected side, the muscle girth of both upper limb was assessed and compared by using Lacote method as described in Table 4. The deep tendon reflex examination was done which was described in table 5 below. For the assessment of the denervated and innervated fibres, strength duration (SD) curve was used as an electrodiagnostic test. The following curve was observed during baseline evaluation (before the administration of intervention) of the extensor digitorum muscle. To determine wrist and hand disability Chedoke Arm and Hand inventory (CAHAI) was used and the patient's score was According to history and examination, and investigation reports a provisional diagnosis of wrist drop secondary to post traumatic soft tissue radial injury was made. The following treatment goals were planned.

- Reducation of muscle
- Prevent muscle wasting
- Prevent deformity and contractures
- To improve functional independence

#### Physiotherapy management

The treatment protocol according to problem list & goals are described in following Table

**Tab.1- Treatment Regime**

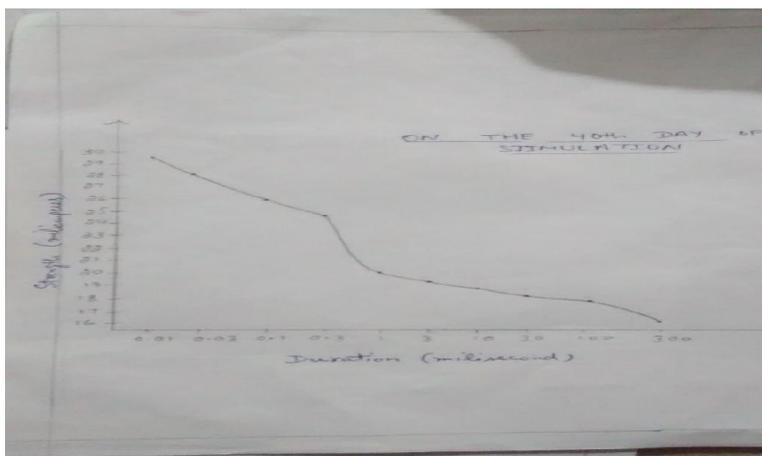
1.To reeducation of muscle	Interrupted Galvanic current- Extensor digitorum, Extensor Carpi Radialis longus and brevis, Extensor carpi ulnaris and Extensor pollicis longus- 60 contractions 3 sets of each muscle through pen electrode was given.
2.To stimulate palmar abduction and rotation of thumb (opposition)	•Hold forearm in mid position and wrist in extension, while patient attempts to grasp and release cylindrical object.
3.To stimulate opposition of radial and ulnar sides of hand (cupping of the hand)	•Forearm in supination, patient practices opposing thumb and the other fingers, particularly 4 <sup>th</sup> and 5 <sup>th</sup> finger.
4.Train control over the manipulation of objects	•Practice picking up various small objects between thumb and each fingers like marbles. •Picking marbles out of a bowl and releasing them into another bowl. •Practice picking up polystyrene cup around the rim without deforming it. •Practice picking up a piece of paper from his opposite shoulder •Put fingers around a refrigerator door handle or around a drawer handle. Open and close the door or drawer. •Using touch screen mobile phone for playing games (fruit ninja, snowball). •Cut the paper into small pieces with the help of scissor •Stapler or punch the bunch of papers. •Click the pen up and down.

**Prognosis:** After giving above mentioned physiotherapy treatment for 45 days (5 days per week), patient was reassessed & following prognosis was observed in the patient.

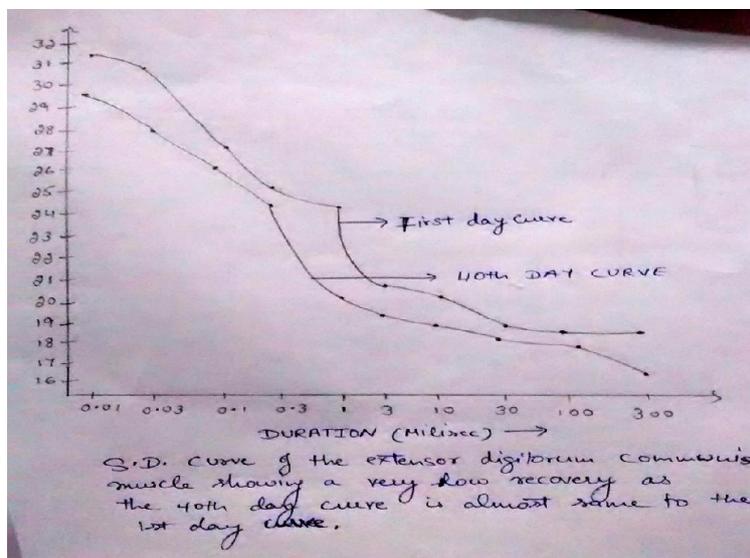
**Tab.2. Outcome measurements to evaluate the prognosis before and after the treatment**

Measure	Score (baseline Evaluation)	After 45 days
1. CAHAL-9	25/63	34/63

**Outcome Variable 2:** Strength Duration Curve Comparison Before and after Treatment of Extensor Digitorum Muscle.



**Graph 2. Strength Duration Curve of Extensor Digitorum before the administration of intervention**



**Graph 3. Comparison of Strength Duration Curve of Extensor Digitorum before the administration of intervention**

## DISCUSSION

Arnold *et al.* reported that the outcome of nontraumatic compressive radial neuropathy is better than the outcome after trauma. Therefore, in most cases, primary treatment should involve conservative management, including observation, non-steroidal anti-inflammatory medications, avoidance of provocative activities, and the use of wrist splints. However, if symptoms persist after 3 to 6 months despite proper managements, neurolysis may be considered. In the present Study, there was no significant change observed in the readings on the comparison of SD curve at Baseline evaluation and after intervention. The prognosis has been reported to be bad, denervation findings on needle SD curve and severe initial weakness are reliable indicators for a chance of poor recovery in the patient.

## Conclusion

It was concluded that the chance of prognosis in the patient was poor because proper management was not taken by him in initial case and now patient was considered as a case of neurolysis of radial nerve.

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