To Explore the Effect of 3 Sessions of Percutaneous Electrical Nerve Stimulation (PENS) on Wrist Flexor Spasticity and Motor Function in Stroke Individual.

***Dr. Sanjivani N. Kamble (PT)[1] Ayushi Joshi[2], Axuna Patel[3], Dr. Gaurang D. Baxi PhD[4] & Dr. Tushar J. Palekar PhD[5]**

Department of Physiotherapy, Dr. D.Y. Patil College of Physiotherapy, Dr. D.Y. Patil Vidyapeeth, Pune[1]
**Corresponding Author Email: dhotesanjivani@gmail.com [1]*
Contact no.+91 9860117191
Dr. D. Y. Patil College of Physiotherapy, Dr. D. Y. Patil Vidyapeeth, Pune.[2]
email:ayushijoshi80@gmail.com [2]
Contact no.+91 9763013029

Dr. D. Y. Patil College of Physiotherapy, Dr. D. Y. Patil Vidyapeeth, Pune[3]
email:axunapatel98@gmail.com [2]

Contact no.+91 8469491095

D. Y. Patil College of Physiotherapy, Dr. D. Y. Patil Vidyapeeth, Pune.[4]
D. Y. Patil College of Physiotherapy, Dr. D. Y. Patil Vidyapeeth, Pune.[5]

Abstract

To introduce PENS as a method for treatment of wrist flexor spasticity and motor function in affected upper limb in a stroke patient.

METHODS: The flexor carpi radialis(FCR) and Ulnaris(FCU) muscles on the affected side where needled. The patient received PENS for 15mins, 3 sessions. outcomes where Modified Modified Ashworth Scale(MMAS), H-(Amplitude), Modified Tardieu scale(MTS) and wolf motor functional test(WMTS). All the outcomes were measured pre, post and follow up after 1 week

Result: After PENS wrist flexor MMAS scores improved from 2 to 1 and was 1 till follow up, H-(Amp) pre (0.50), post (0.17) and follow up (0.24). In MTS the difference between R1 and R2 (pre)10, (post) 15 degrees, WMFT (pre) 45, (post) score improved to 65. Follow up scores for MTS and WMFT were same as the post.

Conclusion: The case report presents PENS as a method for the treatment of poststroke spasticity. Further research recommended.

INTRODUCTION

A stroke is a condition which results in an injured state of peripheral external nervous system which arising from the necrosis of the nerve cells particularity in areas of brain, due to which there is disruption of blood supply to brain cells which result in obstacle or rupture of the blood vessels that transport oxygen and glucose to the brain. Ambulatory disability and impaired activities of daily living is the most common cause of stroke. All the neurological symptoms which appear soon after the stroke commonly differ according to the position and level of the brain lesion, sensory impairments, motor weakness and cognitive impairment. Out of this 15-30% becomes strictly handicapped among the patients who survive and 40% are left with functional deficits.[1]

Spasticity is one of the major features of stroke that can lead to movement limitations and disability. Spasticity is a velocity dependent increase in tonic stretch reflexes with exaggerated tendon jerks, resulting from hyper excitability of the stretch reflex. The prevalence of spasticity 6 months after first-ever stroke is around 43%. Spasticity is defined as "a velocity dependent increase in the tonic stretch reflex with exaggerated tendon reflexes, resulting from the hyperexcitability of the stretch reflex, as one component of the upper motor neuron syndrome"[2]

There are pharmacological and rehabilitation options to treat spasticity. Literature suggests that spasticity can be managed by physical therapy interventions, Needling therapies, i.e., acupuncture and/or botulinum toxin injections are commonly used for the management of spasticity associated with stroke.

DN is an intervention which uses a thin monofilament needle which is manipulated into the muscle to stimulate underlying neural, muscular, and connective tissues[3]. Studies states that DN may impact positively on spasticity, pain and range of motion in the management of adults after stroke.[4] DN improves alpha motor neuron excitability by reducing spasticity in patients after stroke[5]. Studies also states that DN has a positive effect on regional brain activity by restoring the muscle architecture and contractile properties also the changes which occurs after DN in spasticity may be related to intrinsic modification induces in the innervated muscle through a localized stretch of the contracted cytoskeletal structure and reduction of overlap between the actin and myosin filaments[6]. Physical therapists have used DN for the management of spasticity. A few studies have shown the positive effects of DN for the management of spasticity in patients with and stroke, multiple sclerosis, spinal cord injury.[7]

Percutaneous electrical nerve stimulation (PENS) is novel analgesic therapy that combines the advantage of both TENS and electroacupuncture by using acupuncture like needles probes positioned in the soft tissue or muscle to stimulate peripheral sensory nerve's at dermatomal level corresponding to local pathology.

Method

2.1: Design

This was a prospective single case study to report the use of PENS for the treatment of wrist flexor spasticity in an individual with stroke resulting in right hemiplegia. Patient was oriented and has moderate aphasia. Patient was able to walk independently and had hypertension.

2.2: subject

A 59 years old man with a 1 yr. history of ischemic stroke resulting in right hemiplegia. He was alert and oriented. The patient was able to walk independently. Patient had no underlying comorbidities such as cardiovascular diseases, and high blood pressure. He was also right hand dominant.

2.3 Assessment

Before and after PENS outcomes were assessed. Demographic data was recorded including age, occupation, gender, brunstrome recovery stage, MMAS, MTS, WMFT. Wrist flexor spasticity was graded with MMAS as it is an valid clinical measure for spasticity. To assess the excitability of alpha motor neuron, the neurophysiological measures of H- reflex latency were measured pre and post treatment. An EMG machine was used with bandpass filter at 3 Hz to 10 KHz, sweep speed at 2 ms/div, and sensitivity at 200–500 V to record the H reflex and M-response. Paired anode and cathode surface electrodes (silver/silver chloride) were placed on the medial position of the elbow joint, and a rectangular pulse (duration 1 ms) was applied. Maximum H-reflex and maximum M-response were measured as the peak-to-peak amplitude of each response while the median nerve was stimulated at the elbow with the recording electrodes over the FCR muscle. All measurements were taken three times: 1) before DN (T0); 2) immediately after (T3); and 3) on the follow up day (one week later after T3). An experienced physiotherapist performed all clinical and electrophysiological assessments.

2.4 Percutaneous electrical nerve stimulation

After obtaining verbal informed consent the patient underwent treatment of PENS with conventional treatment for 3 session. Muscles treated with PENS were FCR, and FCU on the hemiplegic forearm with the patient in a supine position and forearm in supination. FCR was needled at the medial forearm, 4 cm below the point 1 cm medial to the midpoint of elbow crease. FCU was needled at the midpoint of the proximal third segment of the distance from the medial epicondyle to the ulnar styloid process. Duration of PENS for was 15 minutes. The needle was inserted deeply perpendicular to the skin and TENS was connected to the needle with crocodile electrode.

3. Result:

After DN patient was able to keep his wrist open for a long period of time as compared to before. Before DN MMAS score was 2 and it improved to 1 immediately after treatment. MMAS score post treatment was 1. WMFT pre score was 45 and post score got improved to 65. In MTS the difference between R1 AND R2 (pre) was 10 in post the degree improved by 5% i.e 15 degree. Amplitude for h reflex (pre) was 0.50, after 3 sessions of PENS it got reduced to 0.17 (post). A follow up was taken after a week, the MMAS score was 1, H- AMPL was 0.24, WMFT was the same as post i.e. 65 and MTS was the same as post.

4. Discussion

The most common problem for patients after stroke is spasticity. Spasticity usually limits rehabilitation hence it is important to control spasticity poststroke. The purpose of this case study was to find out the effect of PENS on wrist flexor spasticity.

Essential and confirmatory diagnostic criteria used in DN technique:

- With regard to the first criteria, this was based on the palpable taut band in FCR and FCU muscle that determined the highest degree of tension.
- Second criteria was based upon the restriction of range of motion of extension and increase of resistance to passive movement.
- Visual or tactile identification of a local twitch response (LTR) induced by needle penetration.

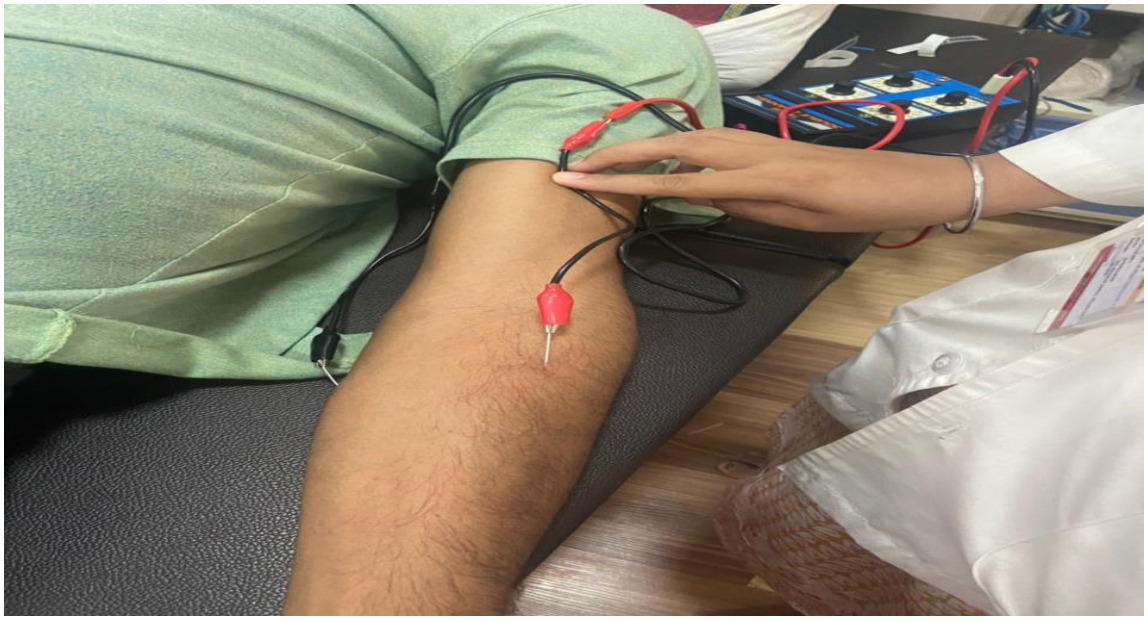
The patient was able to perform hand movements by himself. The patient was able to voluntarily move wrist and hand. The improvement seen in spastic muscle was because of improved alpha motor neuron excitability which is usually seen after DN also in this study there was an additional effect of TENS as it improves motor function in patients with stroke[8]. Levin and Hui-Chan reported that TENS can reduce spasticity and improve motor function in patients with stroke[1] Also, TENS has been hypothesized to regulate spasticity by various mechanism such as reducing stretch reflex excitability, modulation of reciprocal inhibition and by increasing pre synaptic inhibition[9.]

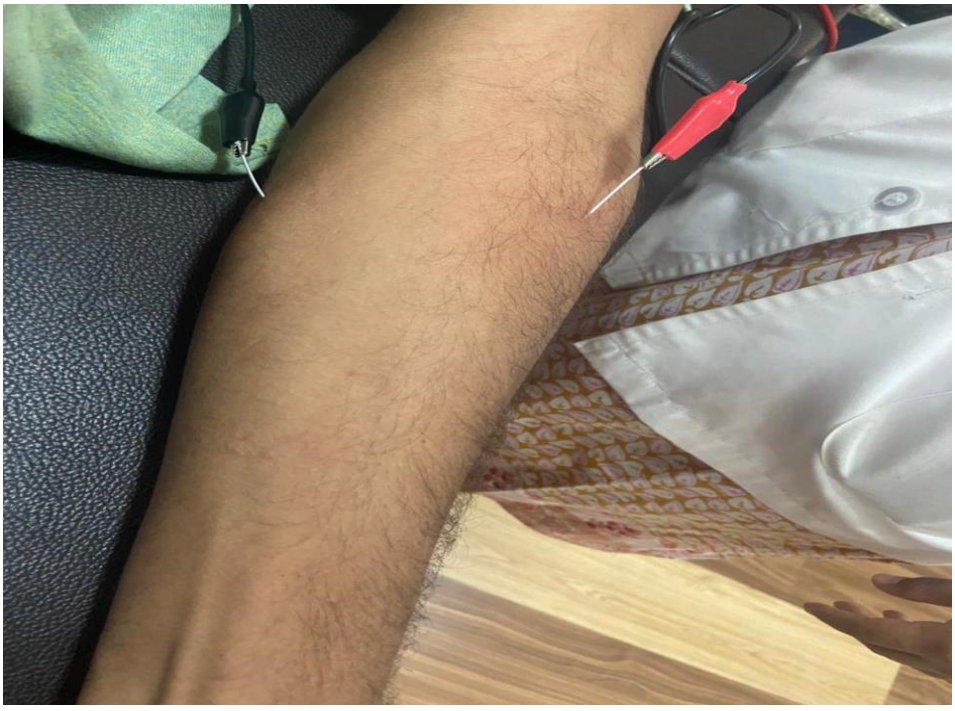
In this case study, two spastic muscles where needled and PENS was applied to the on the needle using crocodile electrode. As, DN acts on central level and TENS acts on local level, DN with TENS may help to carry the impulses towards the central level. So, PENS can have an additional effect in treating poststroke spasticity.

As spasticity is an imbalance between the excitatory and inhibitory fibers due to upper motor neuron lesion. In this case spasticity after treatment got improved in wrist flexor muscles. MMAS scored got improved in wrist flexor, and the amplitude got decreased as an indicator of reduced spasticity. Due to reduction in spasticity, there was improvement in wrist and hand function. there were long lasting functional results after 3 sessions of PENS.

Table 1: **Sample Outcome Datasheet**

Outcome measures	Pre	T1	T2	T3	Post	Follow up
H- REFLEX	0.50				0.17	0.24
MMAS	2				1	1
MTS	10				15	15
WMFS	45				65	65





REFERENCES

1) Rai SS, Ganvir SS. Effect of 2 Weeks of Dual Task Training on Balance and Gait in Patients with Stroke: Single Group Experimental Study.

2) Gallego PH, del Moral OM. A case study looking at the effectiveness of deep dry needling for the management of hypertonia. Journal of musculoskeletal pain. ***2007 Jan 1****;15(2):55-60.*

*3) Ghaffari MS, Shariat A, Honarpishe R, Hakakzadeh A, Cleland JA, Haghighi S, Barghi TS. Concurrent effects of dry needling and electrical stimulation in the management of upper extremity hemiparesis. Journal of acupuncture and meridian studies****. 2019 Jun 1;12****(3):90-4.*

4) Valencia-Chulian R, Heredia-Rizo AM, Moral-Munoz JA, Lucena-Anton D, Luque-Moreno C. Dry needling for the management of spasticity, pain, and range of movement in adults after stroke: A systematic review. Complementary Therapies in Medicine. ***2020 Aug*** *1;52:102515.*

5) Fakhari Z, Ansari NN, Naghdi S, Mansouri K, Radinmehr H. A single group, pretest-posttest clinical trial for the effects of dry needling on wrist flexors spasticity after stroke. NeuroRehabilitation. ***2017 Jan*** *1;40(3):325-*

*6)Núñez-Cortés R, Cruz-Montecinos C, Latorre-García R, Pérez-Alenda S, Torres-Castro R. Effectiveness of dry needling in the management of spasticity in patients post stroke. Journal of Stroke and Cerebrovascular Diseases****. 2020 Nov*** *1;29(11):105236.*

7) Hadi S, Khadijeh O, Hadian M, Niloofar AY, Olyaei G, Hossein B, Calvo S, Herrero P. The effect of dry needling on spasticity, gait and muscle architecture in patients with chronic stroke: A case series study. Topics in stroke rehabilitation. ***2018 Jul*** *4;25(5):326-32.*

8) Ping Ho Chung B, Kam Kwan Cheng B. Immediate effect of transcutaneous electrical nerve stimulation on spasticity in patients with spinal cord injury. Clinical Rehabilitation. 2010 ***Mar;24(3):202-10.***

9) Mahmood A, Veluswamy SK, Hombali A, Mullick A, Manikandan N, Solomon JM. Effect of transcutaneous electrical nerve stimulation on spasticity in adults with stroke: a systematic review and meta-analysis. Archives of physical medicine and rehabilitation. ***2019 Apr*** *1;100(4):751-68.*