

CASE STUDY

IJPHY

EFFECT OF UNIPOLAR ACU-STIM ON MUSCLE RE-EDUCATION FOLLOWING TENDON TRANSFER – A CASE STUDY

¹Uday Raj J²Prof. Srikanth R³Khyati G⁴Balakrishna G

ABSTRACT

Background: Tendon transfer surgery is usually done to improve function, following damage to either major nerve trunks or peripheral nerves. Re-education of the muscle is of utmost importance to gain functional activity. To achieve this, along with re-education exercises, faradic stimulation is usually used. Unipolar Acu-Stim (UAS), is an innovative technique where an acupuncture needle is used to stimulate the transferred tendon with Surged Faradic Currents (SFC). The objective of the study is to identify if the application of SFC using UAS method, is effective to re-educate a transferred muscle.

Case Description: The subject was a 24 year old male who had a loss of finger and thumb extension following Posterior Interosseous Nerve (PIN) palsy, for which Flexor Carpi Radialis (FCR) was transferred to Extensor Digitorum Communis (EDC) and Palmaris Longus (PL) was transferred to Extensor Pollicis Longus (EPL). Following removal of the POP, UAS with surged faradic current was applied for 4 weeks along with re-education exercises. Prognosis of finger extension was assessed by goniometry and video recordings.

Outcome: At the end of 8th week, as observed on goniometry and video recordings, complete finger extension was achieved.

Discussion: UAS with SFC, is useful in re-education of a transferred muscle, as desired movement can be achieved with low intensity.

Keywords: Acu-Stim, Surged Faradic Current, Electric Stimulation, Tendon Transfer, Electroacupuncture, Muscle Re-education.

Received 03rd January 2015, revised 24th January 2015, accepted 01st February 2015



www.ijphy.org

DOI: 10.15621/ijphy/2015/v2i1/60039

CORRESPONDING AUTHOR

¹Uday Raj Juttuka MPT

Assistant Professor,
Apollo College of Physiotherapy,
Apollo Hospital,
Jubilee Hills,
Hyderabad – 500033.

²Professor and Head of Department,
Department of Plastic and
Reconstructive Surgery.

³Post Graduate, College of Physiotherapy.

⁴Under Graduate, College of Physiotherapy.
Nizam's Institute of Medical Sciences,
Punjagutta, Hyderabad – 500082.

INTRODUCTION

Tendon transfer is a surgical procedure in which one normal musculotendinous unit is detached from its insertion and reattached in a new location to restore the function and balance of a nonfunctioning musculotendinous unit.¹ Following tendon transfer, re-education is necessary for the muscle to learn a new action, from which it was previously performing. For this surged faradic current (SFC), a low frequency short duration current is usually used. During stimulation, the patient is asked to actively perform the movement for which the muscle is being stimulated, thereby training the muscle to learn the new action.^{2,3}

Acupuncture is a part of traditional Chinese medicine in which fine needles are inserted into specific points on the body.⁴ It can be used in conjunction with electric stimulation, called as Electroacupuncture (EA).^{4,5} It was first developed in France during the early 19th century when few physicians and researchers began to apply mild electric current to Chinese acupoints. Dr. Louis Berlioz was one of the first physicians who used EA to treat neuralgia. Two British studies on treating Sciatica with EA were published in 1915 and 1921. A German physician by the name of Reinhold Voll systemized the procedure and made several innovative uses of EA which is still used by many practitioners worldwide.⁶

Western Medical Acupuncture is an adaptation of Traditional Chinese Acupuncture, using the current knowledge of Anatomy, Physiology and Pathology and principles of evidence based medicine. In the 19th century, doctors in the United Kingdom, simply needled the sites of maximal tenderness to relieve musculoskeletal pain.⁷ It is mainly practiced by conventional doctors, physiotherapists, nurses and other health care practitioners working within the western health service, mostly in primary care but also in rheumatology, orthopaedic and pain clinics.⁸

EA uses a pair of needles which are inserted into specific points on the body. The needles are then attached to a low frequency device (TENS) that generates electric pulses using small clips.^{4,5} These devices are used to adjust the frequency and intensity of the impulse being delivered, depending on the condition being treated. EA allows stronger stimulation with less tissue damage⁹. Studies show EA reduces pain¹⁰ and recently a study has been done that shows EA can be used in treating peripheral facial paralysis.¹¹ In these studies TENS (Transcutaneous Electric Nerve Stimulation) a low frequency current was used.

EA should not be used on patients who have a history of seizures, epilepsy, heart diseases or on patients with pacemakers. Contact dermatitis to stainless steel needles, local inflammation and bacterial abscess can occur due to reusing of the same needle (unsterilized).¹² However, it can be administered to patients with stroke and other conditions under supervision

Faradic currents, due to their low pulse duration, are primarily used to produce contraction of innervated muscles and they are surged to produce a tetanic contraction. Very negligible amount of chemicals are formed when faradic currents are applied, as the pulse duration is too small.¹³

Unipolar Acu-Stim (UAS) method uses a single acupuncture needle, which is inserted into the muscle or motor point. This acts as the active electrode. A carbon or plate electrode is used as the passive electrode. This is placed at a point along the course of the nerve innervating the muscle to be stimulated. The active electrode is placed distal to it. It has been proved that surged faradic stimulation along with re-education exercises help re-educate transferred muscles.⁴ The aim of this case study is to provide a base that surged faradism with UAS method can be used to reeducate a transferred muscle along with normal reeducation exercises.

METHODOLOGY

VB a 24 year old male sustained an injury to the dorsal aspect of the forearm below the elbow, in 2007 during an accident. He was treated locally for the open wounds. Later he noticed that he was unable to extend his fingers and thumb. Doctors suggested physiotherapy, which showed no improvement. In 2013, he was referred to the Department of Plastic and Reconstructive Surgery, Nizam's Institute of Medical Science, Hyderabad, Telengana, India. On detailed examination and investigation (ENMG study) it was found that his Posterior Interosseous Nerve was not functioning. He was then operated for tendon transfer of Flexor Carpi Radialis (FCR) to Extensor Digitorum Communis (EDC) for finger extension and Palmaris Longus (PL) to Extensor Pollicis Longus (EPL) for thumb extension.

Following tendon transfer, POP cast was applied with the wrist, the metacarpo phalangeal joints (MCP), the proximal interphalangeal joints (PIP) and the distal interphalangeal joints (DIP) of the fingers in complete extension for 3 weeks. At the end of 3rd week, the POP cast was taken off and sutures were removed.

Study procedure was approved by the Head of the Plastic and Reconstructive Surgery Department, NIMS. Informed consent was taken from the patient. Physiotherapy, which included UAS (Appendix1) and re-education exercises, was started at the 4th week.

Materials

1. Electric stimulator – HMS Indostim 201.
2. Carbon pad electrode (passive electrode).
3. Gel or lint pad and water.
4. Sterile disposable single use needle (0.25x40) (active electrode).
5. Alcohol swabs / spirit.
6. Cotton balls.
7. Goniometer
8. Video Camera - SLR camera of 300 DPI resolution.

Treatment parameters

1. Type of current – Surged Faradic
2. Pulse duration – 1ms
3. Electrode placement – Unipolar – Passive electrode at antero-medial lower arm just above the medial epicondyle (course of median nerve) and Active electrode in the FCR muscle.
4. Intensity – current should cause a tetanic contraction
5. Each session – 30 contractions / 3 sets with 1 min rest between sets.
6. Number of sessions – 1/day, 6days/week for 4 weeks
7. Re-education exercises.



Fig 1: Passive electrode placement



Fig 2: Active electrode placement

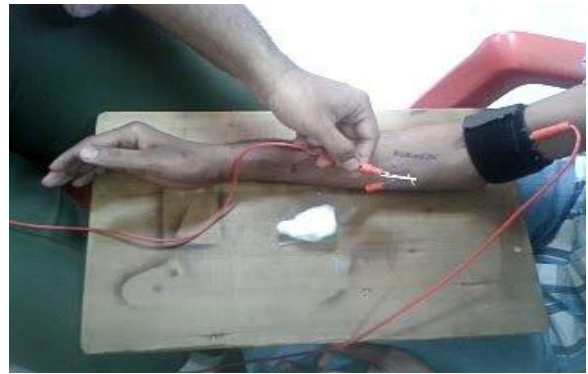


Fig 3: Unipolar Acu-Stim

Week 4 – 6

- EA with active voluntary finger extension.
- Gravity assisted finger extension – 30 repetitions / 3 sets / 2 hourly.
- Gravity eliminated finger extension – 30 repetitions / 3 sets / 2 hourly.
- Gravity eliminated tenodesis exercises.
- Gentle fist closing – 5 to 10 repetitions / 3 sets / 2 hourly.
- (Complete finger extension in gravity eliminated plane and hook fist was achieved by the end of 6th week)

Week 7 – 8

- Continuing EA with active voluntary finger extension and previous exercises.
- Gentle resistance training to finger extension in gravity eliminated plane – 10 repetitions / 3 sets / 4 hourly.
- Against gravity active finger extension – 30 repetitions / 3 sets / 2 hourly.
- Against gravity tenodesis exercises.
- Complete fist closing exercise was encouraged progressively.
- (Complete finger extension against gravity and full fist was achieved by the end of 8th week)

Week 9

- EA was stopped.
- Resistance training to finger extension against gravity – 10 repetitions / 3 sets / 4 hourly.
- Gentle grip strengthening was encouraged.
- Light ADLs was encouraged.

OUTCOME

UAS was given for 4 weeks along with re-education exercises and the outcome was measured by Goniometry and Video recording. Descriptive statistical analysis was carried out in the present study. Outcome measurements analyzed are presented as mean \pm SD. Significance is assessed at 5% level of significance, with p value set at <0.05 which is considered statistically significant difference.

RESULTS

Complete extension of the fingers and thumb was achieved without compromising finger flexion which is necessary for gripping.



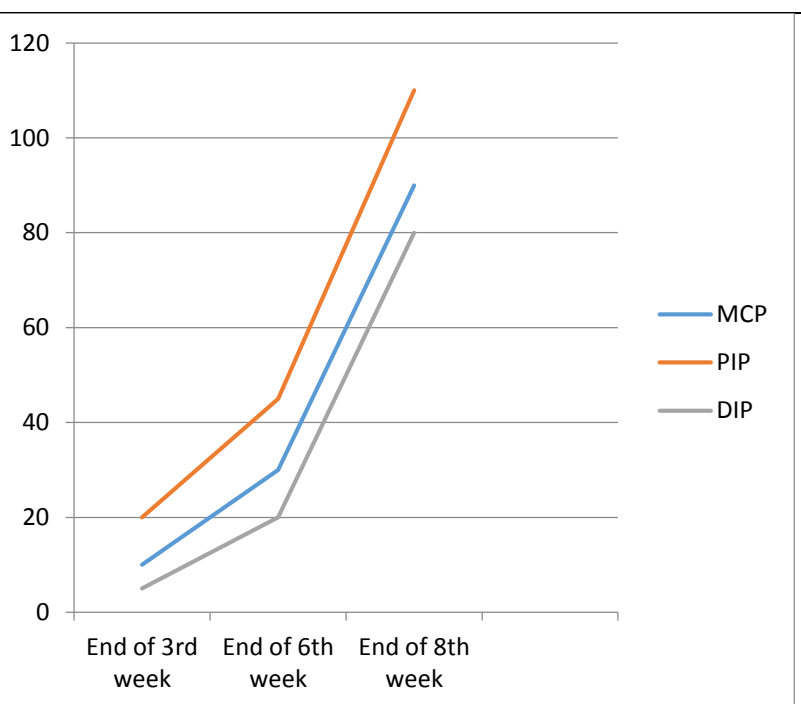
Fig 4: Complete Finger Extension



Fig 5: Complete fist

	End of 3 rd week	End of 6 th week	End of 8 th week
MCP	0 ⁰ -10 ⁰	0 ⁰ -30 ⁰	0-90
PIP	0 ⁰ -20 ⁰	0 ⁰ -45 ⁰	0-110
DIP	0 ⁰ -5 ⁰	0 ⁰ -20 ⁰	0 ⁰ -80

Table 1 – Range of motion of fingers



Graph 1 – Line diagram of improved ranges of fingers

DISCUSSION

According to Beavor's theory, the brain appreciates movements and not individual muscle action. In tendon transfers, the muscle is required to perform a new/different action from which it previously performed. For this faradic current is required to stimulate the muscle in the new pattern. Very negligible amount of chemicals are formed at the electrodes as faradic stimulation has slow pulse duration. During the treatment, the patient must concentrate on the new movement and try to assist it along with voluntary contractions. Once the subject is able to perform the new movement actively, electric stimulation can be discontinued.^{2,3}

Electrode size is very important. Same size electrodes are used for sensory stimulation and different size electrodes produce a motor response. This is because the current densities will be equally distributed if the electrodes are of the same size. If different sized electrodes are used, the current

density is more at the smaller electrode (active electrode) causing a motor response.^{13,14} This might be one of the reasons that brought about improvement in the muscle function.

While stimulating with a pad or pen electrode, the current has to pass through various tissue resistances eg: skin-3200Ω, epidermis 1000Ω etc.¹³ Thus more intensity of current is needed to surpass these resistances. The forearm is a compartment where muscles are closely arranged and increasing the intensity causes the muscles within its vicinity also to be stimulated (as current spreads), thereby the patient will not be able to appreciate the specific movement. Thus there is a need to use a smaller electrode that could surpass these layers. Hence a needle electrode used in this study gave the desired movement.

With Unipolar Acu-Stim, effective stimulation of the muscle is achieved, due to the reduction of tissue resistance, as the needle surpasses them; because it is directly inserted into the muscle and

stimulated. Thus less intensity will be required to stimulate the muscle and the patient will be able to appreciate the specific movement better. UAS along with re-education exercises¹⁵ helped with the improvement in the current study. Although a significant improvement was observed in the muscle activity for range of motion, muscle power was not quantified objectively. Thus, future studies must consider manual muscle testing and also other instruments like dynamometer, etc., for objective measure of improvement.

CONCLUSION

It was observed that Unipolar Acu-Stim with Surged Faradic Current proved to be effective in muscle re-education following tendon transfers. However, re-education exercises also played an important role.

Acknowledgements: The author would like to sincerely thank Varalakshmi Duddela (MPT) and Shalini Kurra (MPT) for their kind support.

Appendix 1: Video of the technique performed: <http://youtu.be/HrIhL0tbMwc>

REFERENCES

1. Stedman's Medical Dictionary. Lippincott Williams and Wilkins; 2006.
2. Petrofsky JS. Electrical stimulation: Neurophysiological basis and application. *Basi ApplMyol*. 2004;14(4):205-13.
3. Singh J; Step by Step: Practical Electrotherapy. 2nd edition; 2006.
4. Hicks; Angela. The acupuncture handbook: how acupuncture works and how it can help you.2005.
5. Ellis, A; Wiseman N; Boss K. Fundamentals of Chinese Acupuncture. Revised edition; 1991.
6. Aung S, Chen W. Clinical introduction to medical acupuncture.2007.
7. Baldry P. The integration of acupuncture within medicine in the UK—the British Medical Acupuncture Society's 25th anniversary. *Acupunct Med*. 2005;23(1):2-12
8. Price J, White A. The use of acupuncture and attitudes to regulation among doctors in the UK—a survey. *Acupunct Med*. 2004; 22(2):72-4.
9. Connor J; Bensky. Acupuncture: A comprehensive text. 1st edition; 1981.
10. Payton OD, Manual of Physical Therapy.1989.
11. Mayor DF. Electroacupuncture: An introduction and its use for peripheral facial paralysis. *Journal of Chinese Medicine*. 84;2007.
12. Norheim AJ. Adverse effects of acupuncture: a study of the literature for the years 1981-1994. *J AlternComple-ment Med*. 1996;2(2):291-97.
13. Robertson V, Ward A, Low J, Reed A. Electrotherapy Explained: Principles and Practice. 4th edition; 2005.
14. Forster and Palastanga. Clayton's Electrotherapy: Theory and Practice. 9th edition; 2006
15. Kisner C, Colby LA. Therapeutic Exercise-Foundations and Techniques.2002.

Citation

Uday Raj J, Prof. Srikanth R, Khyati G, Balakrishna G. (2015). EFFECT OF UNIPOLAR ACU-STIM ON MUSCLE RE-EDUCATION FOLLOWING TENDON TRANSFER – A CASE STUDY. *International Journal of Physiotherapy*, 2(1), 347-351.