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EFFECTIVENESS OF HAND SPLINTING AND SENSORY RE-EDUCATION TO REGAIN FUNCTIONALITY AFTER WRIST DROP

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ABSTRACT

Hand problems, which could be cosmetic or functional or both, are hard to hide. Hands function affectedly concern to gesture and express, touch and care, dress, and feed. Impairments can be annihilating. The incidence of upper extremity injuries is significant and accounts for about one-third of all injuries. This study is conducted in order to find the effectiveness of splinting and sensory reeducation in the patient with wrist drop. A different subject prospective, experimental, flexible pre-and-posttest intervention design followed by descriptive analysis with questionnaire has been used for the purpose of this study. Baseline screening assessment was done by using DASH, Goniometer, oxford grading for muscle strength and monofilaments. Out-trigger hand splint was provided to all the subject. Sensory re-education training was given to the patients with conventional therapy for better result, 5 days/week over a period of 12 weeks. After 12 weeks of therapy, post-test will be done by using DASH, Goniometer, oxford grading for muscle strength and monofilament to obtain results. The unpaired t test (for quantitative data to compare two independent two groups was used for quantitative data comparison of all clinical indicators. Chi-square test and fisher exact test were used for qualitative data whenever two or more than two groups were used to compare. Level of significance was set at P≤0.05.The individual overall growth has been considered in the therapy sessions as the patient's personal life, self-confidence, locomotion and day to day activities were hampered but after therapy session the individuals each aspect has overall growth including muscle strength which helps the patient to lift weight up to 2kg and make them able to hold the objects of different size and shapes for e.g. mainly patient has developed cylindrical, conical and spherical grasp.

KEY WORDS : *Sensory re-education, Wrist drop, DASH, Splinting, Functionality*

INTRODUCTION

Hand problems, which could be cosmetic or functional or both, are hard to hide. Hands function affectedly concern to gesture and express, touch and care, dress, and feed. Impairments can be annihilating. The incidence of upper extremity injuries is significant and accounts for about one-third of all injuries. As we have a male presiding society, approximately viable individuals of 21 to 30 years contribute 50% of the patients of which 22.9% were labourers and students1. (Ashish Gupta Indian journal of surgery 10th June 2012) The purpose of this research is to discover and focus on one of the hand impairment which is radial nerve palsy or we can say wrist drop.

Wrist drop is the state in which the radial nerve develops an impaired nerve function causing paralysis of the extensor muscles of the hand which leads the hand to hang down at the radio carpal joint, this also results in early degenerative joint changes

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promoting malnutrition2. (Pat McKee Journal of Hand Therapy March 2007) The radial nerve is responsible to carry signals from the brain to hand and vice-versa. When the radial nerve is injured due to any cause the patient may come across the following symptoms which include numbness in the wrist, back of the hand, and forearm. The terminal branch of brachial plexus contributes to forming radial nerve specifically the posterior cord. So any injury to this certain area like a stab wound such as a knife wound to the shoulder area just below the clavicle may transect the cord and result in radial nerve injury leading to wrist drop. Other causes of wrist drop due to injury to the nerve includes prolonged use of crutches, repetitive actions of the radial nerve, and even maybe due to extensive leaning on the elbow for prolonged periods.

It may also be due to lead poisoning and thiamine deficiency (beriberi). Systemic neuromuscular disorders such as limb-onset amyotrophic lateral sclerosis may mimic wrist drop as well. A humeral fracture may also lead to radial nerve injury since the radial nerve runs via the radial groove on the lateral border of the humerus bone. Other causes known to instigate radial nerve palsy include acute upper limb ischemia or excessive injection of muscle-enhancement oil3. (Alexei DeCastro NCBI 12 September 2019)

Now the question arises "what is the role of an occupational therapist in treating wrist drop?" So the role is very significant as to overcome the limitation in their activities of daily living as patients face difficulties in both motor and sensory aspects. As per research on radial nerve palsy, they suggest that clinical examiner should examine all the muscles that are supplied by radial nerve i.e. triceps forearm supinator and wrist and finger extensors should be tested for the function and the strength. They have also mentioned that clinician should check for the sensation at the dorsum of the hand, lateral three and a half fingers as well as the arm and forearm4. (Marko Bumbasirevic EFFORT Open Rev. 2016)

These impairments lead to changes in cortical representation because of the absence of afferent stimuli in those areas5. So the sensory and motor re-education program in the early post-operative phase helps to feed the somatosensory cortex which is followed by preservation of the cortical representation of the hand and finally improves and facilitates better results in the functionality of the individual6. To have a better result in treatment of wrist drop it is proved that with sensory re-education with customized lightweight, dynamic splints the result is most effective.7, 8.9,10 (Alsancak S. Prosthet Orthot Int. 2003)

However, there is still a lot of need for researches and studies that address splinting and sensory re-education which is effective in increasing the functionality of an individual, who is suffering from a wrist drop.

Therefore we hypothesized that sensory re-education and splinting with conventional therapy in the early post-operative phase would give significantly good results functionally. Therefore, the objective of this study was to analyse the effectiveness of these techniques to improve functionality in wrist

MATERIAL AND METHODS

Design

Single group pretest posttest experimental design followed by descriptive analysis.

A different subject prospective, experimental, flexible design has been used for the purpose of this study.

Subjects

A total number of 30 adults with wrist drop, age 20 to 45 year both male and female are included and post-operative cases like plastic surgery or nerve grafting are taken. After explaining the study procedure and obtaining the consent form according to the patient's desire, a baseline screening assessment will be done by using DASH, Goniometer, oxford grading for muscle strength and monofilaments. Out-trigger hand splint will be provided to all the subject. Sensory re-education training will be given to the patients with conventional therapy for better result, 5 days/week over a period of 12 weeks. After 12 weeks of therapy, post-test was done

Inclusion Criteria

- Adults with wrist drop
- Age 20 to 40 year (male and female)
- Post – operative (plastic surgery or nerve grafting)

Exclusion Criteria

- Adults with any other nerve injuries associated such as median nerve injury or ulnar nerve injury.
- Subjects diagnosed with any other neurological disorders.
- Subjects who are unable to follow commands

Outcome measure used for work skill assessment

- **Goniometer**
  A goniometer is an instrument that either measures an angle or allows an object to be rotated to a precise angular position.

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To maximize reliability always use the same goniometer, positioning, procedure and examiner

- **Oxford Grading for MMT(Manual muscle testing)**
  The Oxford Scale is a quick method of assessing and grading muscle power. A detailed knowledge of muscle anatomy is required to carry out an assessment appropriately. The Oxford Scale is a 0-5 scale which is then recorded as 0/5 or 2/5, sometimes with a + or - sign to indicate more or less power but not sufficient to reduce or increase the number.
- **Semmes-Weinstein monofilament**
  Monofilament testing is an inexpensive, easy-to-use, and portable **test** for assessing the loss of protective sensation.
  The Semmes-Weinstein monofilament (SWM) testing is one of the clinical **tests** that measures the response to a touching sensation of the monofilaments using a numerical quantity.

FIG 1. Monofilament set used for sensory examination

Splinting

Splinting is advised in peripheral nerve palsy to correct the deformities by using standard splinting designs. There are few principles of splinting which has to be followed;

- To upkeep the overstretched position of the muscle which is denervated.
- Contractures has to be prevented.
- Strong substitution patterns should not be developed.
- Maximization of the hand functionally.

Patient with radial nerve palsy has good chances and moderate potential to use hand normally[12]. (Burkhalter WE, Clin othop Rel Res, 1974, 104:68) But there is a great positive result when we use dynamic splint as they are designed to increase passive motion. A dynamic splint includes a resilient component (elastic, rubber band, or spring), which with the patient can move the affected part.[13]

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FIG 2. Radial palsy splint that re-creates normal tenodesis action by the springs. (From colditz j: j hand therapy 1:19, 1987)

FIGURE 3 Out-Trigger Hand Splint Worn By the Patient

PROGRAM DESCRIPTION

Subjects will be selected based on inclusion criteria i.e. adults with wrist drop, age 20 to 45 year both male and female are included and post-operative cases like plastic surgery or nerve grafting are taken. After explaining the study procedure and obtaining the consent form according to the patient's desire, a baseline screening assessment will be done by using DASH, Goniometer, oxford grading for muscle strength and monofilaments. Out-trigger hand splint will be provided to all the subject. Sensory re-education training will be given to the patients with conventional therapy for better result, 5 days/week over a period of 12 weeks. After 12 weeks of therapy, post-test will be done by using DASH, Goniometer, oxford grading for muscle strength and monofilament to obtain results.

Patient received a session of 45 min individually. Which was started with range of motion exercises and stretching, 10 repetition each approximately. Retrograde massage was given to the patient for 5 min with some lotion applied to the affected area for easy manipulation.

This was further followed by deep pressure proprioception and different texture handling by keeping different texture tool kit on table top and making them feel differences between each texture by giving stroke of those texture 10 repetition

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respectively. Then patient was asked to do Nirmal hand table activity for each finger 15 repetition of weight, according to their muscle power accompanying it with supination and pronation afterwards at least 10 repetition of each range. Then Out trigger splint was provided to the patient and was asked to perform place and hold exercises with peg boards 20 repetition with different size and shape peg boards. Then 2 min rest for the patient in which he was performing deep breathing exercises. The last two activities were as follows first was the Mirror visual feedback / mirror training in which patient was performing range of motion exercises in front of a mirror with normal limb involved 5 repetition of each movement 2 sets of it. Second was the object recognition using greatly varied objects in shape, material, size and weight 10 repetition 2 sets of it.

Splinting wearing schedule that was followed by the patient after instructing them and giving knowledge about when and how to wear splint. Patient was not allowed to use splint at the night time while sleeping. Splint was mostly used while doing Activity of Daily Living (ADL) specifically combing, eating and holding objects. During daytime, splint was worn by the patient for 1 hr. and then he/she remove it for 2 hours and then they repeat.

RESULT DISCUSSION AND JUSTIFICATION

30 patients participated in the experiment and individually got the therapy session of 45 minutes in which the mean age of the patient was 32.26±8.18 percent. The maximum participant were males with percent of 63.3 and females were 36. 7 percent. No participant withdraw their name during 3 months of protocol given to them. The demographic data analysis shown in the table given below

Table 1 Age

	Frequency	Percent
20-30	14	46.7
30-40	12	40.0
>40	4	13.3
Total	30	100.0
mean±SD	32.26±8.18	

Table 2 Gender

	Frequency	Percent
Female	11	36.7
Male	19	63.3
Total	30	100.0

Table 3 DASH

Group	Mean	Std. Deviation	Mean differences	P value
Pre	66.96	4.99	18.62	
Post	48.34	5.29		0.001 (S)

Table 3 Dash questionnaire scoring comes in range of 0 to 100. The criteria involve highest the number the more the disability.The pre-test mean value is 66.96 and post-test mean value is 48.34 that signifies the patient was having more disability before the therapy was given to the patient.

Table 4 Range of motion

Ranges	P Value
Flexion/extension wrist	0.001 (S)
Supination/pronation	0.001 (S)
Radial/ ulnar deviation	0.001 (S)

P value=0.001 (S)

Table 4 Range of motion was measured with the help of goniometer in degrees the ranges which are considered standardized for healthy being was the highest scoring for the particular patient the pre-test scoring and post-test scoring was compared in each individual in each motion that is flexion, extension, pronation, supination, ulnar deviation and radial deviation of wrist the more the degree near to the standardize degree of motion the result will be positive.

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Table 5 Manual muscle testing

MMT	P Value
Flexion/extension wrist	0.001 (S)
Supination/pronation	0.001 (S)
Radial/ ulnar deviation	0.001 (S)

P value=0.001 (S)

Table 5 Manual muscle testing was done by how Florence P. Kendall described it, with the standardize charting where is 0 signifies no contraction and 5 signifies normal muscle strength. The higher the value more the individual is in healthier side in respect to muscle strength.

Table 6 Semmes Weinstein monofilament

Ssemmes Weinstein monofilament	P Value
Normal and Diminished light touch	-
Diminished protective sensation	0.001 (S)
Loss of protective sensation	0.001 (S)
Deep pressure sensation	0.001 (S)

P value=0.001 (S)

Table 6 Semmes Weinstein monofilament are nylon thread which are having different evaluator size, target force and thresholds which individually signifies whether the person feels the respective threshold. The target force of 0.008-0.07 signifies Normal threshold, 0.16-0.4 signifies diminished light touch, 0.6-2 signifies diminished protective sensation 4-180, signifies loss of protective sensation 300 signifies deep pressure.

The study revealed that the participant wearing splint for given time and has taken the therapy session from the occupational therapist has shown a greater symptom relief and increase in the participation of activities of daily living. The sensation has significantly improved in the individual, the pre-test shows a wide range of disability which further in post-test decreased significantly showing decrease in patient's symptoms like stiffness, tingling, numbness and unable to use the hand. The splinting help the patient to develop the mobility as well as it prevents from the flexor deformity contracture which eventually lead to enhance the functionality of hand and wrist.

The individual overall growth has been considered in the therapy sessions as the patient's personal life, self-confidence, locomotion and day to day activities were hampered but after therapy session the individuals each aspect has overall growth including muscle strength which helps the patient to lift weight up to 2kg and make them able to hold the objects of different size and shapes for e.g. mainly patient has developed cylindrical, conical and spherical grasp.

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