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Prospective study on Beneficial Effects of High Intensity TENS in the Process of development and recovery of Post Stroke Hemiplegic Shoulder Pain

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Abstract:
Introduction: *Hemiparetic Post Stroke Shoulder Pain (HPSSP) is common complication after Stroke. Common factors contributing to HPSSP include subluxation, spasticity of Muscles with imbalance of the gleno-humeral joint, contracture of periarticular Soft Tissues, rotator cuff tendinitis, complex regional pain syndrome (CRPS). Other significant causes are adhesive capsulitis, subacromial bursitis, brachial plexus traction neuropathy, heterotopic ossification, Hemi-neglect, thalamic syndrome (also known as central post stroke pain syndrome) and soft tissue injury or trauma.*
Aims & Objectives: *to assess, evaluate and analyze the effectiveness of different conservative management protocol AND the effectiveness of a specific physical modality like high intensity TENS on prevention and management of HPSSP.*
Materials & Methods: *114 subjects of hemiparetic Stroke patients of both sexes from urban & rural population with complain of shoulder pain attending Physical Medicine & Rehabilitation department were selected as per inclusion and exclusion criteria. Prospective analytical study was conducted for a period of 6 Months using clinical tools like Shoulder Pain and Disability Index (SPADI) and Goniometry by dividing all patients in to TWO MANAGEMENT GROUPS. Group -1 received standard conservative protocol (SCP) for management of HPSSP but Group -2 managed with SCP along with High Intensity TENS. First 6 weeks were used for collection of patients under study then management protocol were applied and later on results were assessed at 8^{th} and 16^{th} Weeks after management. Each Group has been further sub grouped to A, B and C as per the causes of HPSSP. So, total SIX Subgroups were done as A1, A2, A3, B1, B2 and B3 during management and subsequent result analysis.*
Results: *Data were recorded in Microsoft Excel and subsequently analyzed by the statistical software STATISTICA version 6. Numerical variables were non-parametric and compared between two groups by Mann-Whitney U-Test while categorical variables compared by Chi-Square Test or Fisher's Exact Test as the case may be. Friedman's ANOVA was used to assess change in scores over time followed by Wilcoxon's Matched Pairs Signed Rank Test for assessing difference between any two time points. All analysis has been two-tailed and $p<0.05$ has been taken to be statistically significant. After analyzing the result we found that, SCP with TENS improves SPADI pain score in all groups but statistically significant improvement is noted in patients of HPSSP due to Subluxation & Adhesive Capsulitis but mild improvement in rotator cuff tendinitis. Data also shows variable improvement in SPADI-Disability Score in all groups of patients but statistically significant improvement in subluxation Group.*
Conclusions: *We found that most patients with HPSSP are presented in the 7^{th} decade of their life with the mean age of 64.93 for subluxation of shoulder joint, 66.58 for adhesive capsulitis, and 66.67 for rotator cuff tendinitis with a male preponderance over the female with more common affection for left shoulder joint than the right. Subluxation of shoulder joint is major etiology of shoulder pain followed by adhesive capsulitis, rotator cuff tendinitis, CRPS, bicipital tendinitis. Physical modalities improve of pain score at later part of treatment period in HPSSP due to subluxation and adhesive capsulitis. Physiatric management did not show statistically significant improvement of SPADI score for Disability due to adhesive capsulitis and rotator cuff tendinitis*
Key Words: *Stroke, Hemiplegia, TENS, Shoulder Pain*

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I. Introduction

Hemiparetic Post Stroke Shoulder pain (HPSSP) is common complication along with Hemiplegia/Hemiparesis after Stroke. Poduri [(12)] reports that HPSSP occurs at 2 week to-3 months post stroke, it may be as early as 7 days post-stroke (Poulin De CL et al. [(13))]. The shoulder capsule is thin and is composed of two tissue layers : **A)** The **inner synovial layer** is highly vascular but poorly innervated, making it insensitive to pain but highly reactive to heat and cold. **B)** The **outer layer, the stratum fibrosum**, is poorly vascularized but richly innervated, predisposing it to pain from stretch. Proprioceptors end organs within joint capsules can initiate muscular action to stabilize the joint. These are not functional in the flaccid stroke phase. Thus from any passive stretch of the capsules and tendons there may occur a separation of the joint, due to no reflex contraction of flaccid muscles. Faghri [(8)] suggested excessive capsular stretch in post stroke flaccid shoulder predispose capsule to irreversible damage and shoulder pain. Gamble et al. [(4)] described other than flaccidity, glenohumeral subluxation, hemi neglect, spasticity are the risk factors for HPSSP. Hanger and colleagues[(6)] suggested that the cause of HPSSP is multifactorial and different factors contributing at different stages of stroke recovery, i.e. flaccidity contributing to subluxation and subsequent capsular stretch, abnormal tonal and synergy patterns contributing to rotator cuff or scapular instability. Post Stroke Hemiplegia presents in typical posturing with hypertonic muscle patterns with flexor tone predominates causing scapular retraction and depression with internal rotation and adduction of the shoulder due to internal rotator predominance clinically. This is due to loss of higher center activity by withdrawal of pyramidal and extra pyramidal control on motor group. In stroke recovery, the 'synergy pattern' of muscles is inevitable where recovery is incomplete. Stretching of tightened spastic muscles causes more pain. Shortened muscles inhibit movement, reduce range of motion and prevent other movements (*especially at the shoulder where external rotation of the humerus is necessary for arm abduction greater than 90 degrees*). Muscles involved in spastic internal rotation/adduction include the subscapularis, pectoralis major, mainly and, teres major and latissimus dorsi muscles, secondarily. Cailliet [(7)] proposes that the synergy component that usually occurs first is spastic elbow flexion, the shoulder phase is weaker. Release of uninhibited flexion patterns by initiating opposite movements is "key points of control". So it is can be summarized that most important Causes of HPSSP are [(5)]; **A) Glenohumeral subluxation-** especially during the post stroke flaccid stage when due to weight of flaccid arm applying direct mechanical stretch to the joint capsule and traction to unsupportive muscles of the shoulder. Culham et al. (1995) (Canada) [(9)] reported that while patients with low tone had significantly greater subluxation compared to the high tone group (0.52 vs 0.21). **B) Spasticity:** Under normal circumstances a delicate balance exists between facilitating and inhibiting influences upon both alpha and gamma motor neurons, which together maintain appropriate control of skeletal muscle length and strength of contraction at the spinal cord level. After a stroke as the input from supraspinal suppressor (both pyramidal and extra pyramidal motor systems) reduced/stopped entirely, the balance of control over the muscle progressed to facilitation and spasticity results with increased tone and reflexes on the involved side of the body and ultimately with increase of flexor tone synergy develops. Muscles predominantly in shoulder's synergy pattern include adductors (i.e.Teres major, latissimus dorsi) and internal rotators (i.e. subscapularis, pectoralis major). **C) Rotator cuff Tendinosis/rupture:** Impingement of Supraspinatus tendon between acromion and greater tuberosity of humerus causes tendonitis/Tendinosis, subacromial bursitis, or rotator cuff tear. According to Text book of "Physical Medicine & Rehabilitation" by Randall L. Braddom Third Edition, Impingement syndrome has been suggested as a cause of shoulder pain as well as a cause of rotator cuff injury in hemiplegia.[(10),(3)]. **D) Complex Regional Pain Syndrome(CRPS):** Usually in 3-5 months after stroke with upper extremity predominance and is precipitated by bone or soft-tissue injuries. But up to 30% cases no injury is found. Tepperman [(11)] and colleagues reported metacarpophalangeal (MCP) joint tenderness is the best diagnostic indicator, with sensitivity and specificity of 85.7% and 100%, respectively. Davis and coauthors reported that CRPS occurs in 12.5% of patients who have had a stroke, [(16)] while Chalsenand [(17)] colleagues reported the incidence to be 61%. Others Facts of HPSSP are, **E) Adhesive capsulitis**: Glenohumeral capsulitis usually present with pain and limited passive movement of shoulder, especially external rotation and abduction usually in later stage of recovery process, when chronic irritation or injury, inflammation, or lack of movement eventually results in adhesions (Joynt [(10)] reported). **F) Subacromial bursitis:** Presented with radiation of shoulder pain down to arm on its movement. **G) Brachial plexus traction neuropathies/injury**: Causes Pain in Shoulder, **H) Heterotopic Ossification (HO)**: HO presents as calcification of soft tissue around traumatic or neurologically affected joints. HO can present with local erythema, warmth, induration, and swelling. Cailliet [(7)] reported that onset can occur as 2 weeks to 6 months after stroke. **I) Thalamic syndrome:** Thalamic syndrome (*Synonyms- central post stroke pain, analgesia dolorosa, Dejerine-Roussy syndrome*) occurs in less than 5% of stroke survivors, but found in 50% of persons who have had a thalamic stroke. Pain can evolve spontaneously or by touch, and often severe, diffuse, and disabling. Pain is burning, tingling ("pins and needles"), sharp, shooting, stabbing, gnawing, dull, or achy in nature and often refractory to treatment. Patient also experiences hyperpathia (*an exaggerated pain reaction to mild external cutaneous stimulation*). **J) Peri-Articular Soft-tissue injury/trauma:** Usually from uncontrolled

Range-of-Movement (ROM) exercises, poor positioning of hemiplegic/hemiparetic limb, or improper transfer technique. Kumar and colleagues [16] showed that 62% patients using overhead pulley system for therapy and performed ROM exercises experienced HPSSP irrespective of other pathology. Therefore aggressive stretching or ROM Exercises should be avoided during the rehabilitation process.

EPIDEMIOLOGY: HPSSP causes huge medical, social and Economical burden particularly in a developing country like India both to the patient, Family Members, society and country at large. Worldwide prevalence of HPSSP is 34 % [1] to 84% [2]. In the largest cohort of hemiplegic subjects with 11 months follow up shows that shoulder pain occurs in 72% of cases.[3] treating established HPSSP is difficult, early diagnosis and treatment is the crux of its management. Corner stone of treatment of HPSSP remains therapeutic exercise, physical modalities, analgesic and preventive care.

OBJECTIVE OF STUDY: To assess, evaluate and analyze the effectiveness of different conservative management protocol for management of HPSSP, along with the benefits of high intensity TENS on prevention and management of it.

II. Materials & Methods

The present Prospective analytical study was conducted in the department of Physical Medicine and Rehabilitation, Shambhu Nath Pandit Hospital, Kolkata, during the period from January 2009 to June 2009. The institutional ethics committee clearance was obtained. 114 cases were selected from Post Stroke Hemiparetic patients of both sex of urban & rural population with complain of shoulder pain attending the department of Physical Medicine & Rehabilitation both at OPD and IPD in Shambhu Nath Pandit Hospital, Kolkata according to the inclusion and exclusion criteria of the study protocol.

Inclusion criteria **—**1**.**Confirmed case of CVA with shoulder pain at hemiplegic/hemiparetic side.2.Patients of both sexes of age group 18 years and above.3. Patients who had given written consent to enter into the treatment procedure.4.Adequate communication ability to cope with the verbal rating score for pain and disability.5. Patients having no other Neuro-Muscular and musculoskeletal co-morbidities

Exclusion Criteria**—**1. Patients who were not willing or not in a sound mental state to give consent.2. Patients who had pain in other joint or body area apart from shoulder joint of Hemiplegic/hemiparetic side, 3. Traumatic, infective or neoplastic causes of shoulder joint pain. 4. Radiating shoulder pain from other side. 5. Referral pain from other causes. 6. Shoulder pain with sensory changes. 7. Uncontrolled DM. 8. Contraindication of High Intensity TENS, 9. Pregnant woman (of child bearing age) for x-ray, 10. On cardiac pacemaker or metal in situ, 11. Other musculoskeletal Co-morbidities, 12. Other Neuro-Muscular Co-morbidities.

Study Tools **–** A) Shoulder Pain and Disability Index (SPADI) & B) Goniometry. ***Assessment Parameters used*****— A) Clinical Parameter—**SPADI Pain Scale for pain, Goniometry for ROM., **B) Functional Parameter—**SPADI Disability Scale for shoulder functions and **C) Biochemical-Radiological & Pathological Parameter—**X-ray, USG, NCV, ECG, Routine blood examination.

Assessment**—** This prospective analytical study was conducted over a period of approximately 1½ years. Ethical committee clearance with the study protocol and Patient Examination proforma had been prepared. Patient was assessed on first visit (V_1) and after initial assessment the patients had been divided into three main groups according to common prevalence of presentation associated with Shoulder Pain Syndrome in case of hemiplegia (as per data of previous studies and literatures). The Fourth group (group-D) was the miscellaneous group, where HSP patients were having statistically insignificant etiologic presentations. Patients were now divided into shoulder Subluxation (Group A), Adhesive Capsulitis (Group B), Rotator cuff Tendinitis (Group C) and Others (D). Each group of patients had been sub-grouped according to computer generated random number list for allotment and will be given treatment as per standard protocol. All patients were asked for Routine examination of blood, ECG, X-ray of both shoulder joint in one film, USG evaluation of affected shoulder joint for further evaluation and prescribing treatment protocol.

Group-01 (with Sub Group-A1, B1 & C1) has given standard conservative treatment protocol like positioning of limb, early splinting, therapeutic exercise and Paracetamol as analgesic.

Group-02 (With Sub Group-A2, B2 & C2) has been treated on standard conservative treatment protocol along with High Intensity TENS as physical modality for management.

Subsequent 2 visits were done at every 6 weeks intervals, at 6^{th} week (V_2) & at 12^{th} week (V_3) from the date of 1^{st} visit (V_1). All the patients were reassessed by standard musculoskeletal and neurological evaluation and also with SPADI scale as per examination protocol.

Post stroke Proper Handling and Positioning Techniques adopted were:-

1) Support to subluxed shoulder at all times after stroke if the shoulder by placing the affected extremity on a pillow when in bed, on an arm trough in a sitting position, and in a sling or pocket during standing. 2) Avoidance to raise shoulder more than 90 degrees' of flexion without supervision during ADL care like dressing. Here patient will follow the sequence of weaker arm, head, and then stronger arm. Avoid humeral elevation during upper-body dressing and bathing. 3) To prevent soft tissue contracture and malalignment at shoulder joint, a full, pain-free ROM at shoulder joint (especially external rotation) by daily proper approximation techniques shoulder joint malalignment is done. Here while in bed patient will clasp the hands together with thumbs up and lift the hands to shoulder level until elbows are fully extended. Discontinue the activity if any pain occurs. 4) To keep the involved upper extremity in front of his body (resulting *scapular protraction with shoulder flexion*) while assisting on rolling in bed then patient's hand and arm remain across the chest (like making a pledge) and to make sure the arm and hand are supported after rolling over bead is complete. 5) Facilitate trunk symmetry and weight bearing of affected upper extremity while assisting a patient in self-care tasks at the edge of the bed. Here in affected limb the hand remains with palm down on bed (*or affected forearm on a pillow beside the body*) to be used as a stabilizer during bedside bathing or dressing. 6) Extensor muscle strengthening to be encouraged (*just opposite of flexor synergy pattern*) during functional tasks. If any active range of motion remains then patient to encourage reaching away from the body, extending the elbow, and opening the hand.

Physical Modality TENS: - TENS selectively activates low-threshold peripheral afferents (A_β) which inhibits ongoing nociceptive transmission in the central nervous system. The Dose of TENS Prescribed → intensity-50mA, frequency 1-5Hz, and pulse width 150µs for 30 minute per day for 4 weeks**.** High intensity TENS at a threshold which produces muscle contraction of Supraspinatus and deltoid muscle of the hemiparetic shoulder is suggested.

Management Protocol for Sub-Group A (Subluxation) patients: -

1) Sub-Group A_1- Standard Treatment ONLY: - Positioning, splinting (*while patient in bed extremity will rest on pillow and in sitting or standing position extremity should be in arm-sling pouch*) Therapeutic exercise (*to assist the patient to obtain full pain free range of motion for shoulder joint, esp. external rotation*), avoidance of overhead pulley exercise, Tab Paracetamol 1gm t.i.d as analgesic for 2wks.

2) Sub-Group-A_2- Standard Treatment + High intensity TENS (*intensity-50mA, frequency-1-5Hz, and pulse width 150µs for 30 minute per day for 4wks*) over Supraspinatus and Deltoid muscle of affected shoulder

Management Protocol for Sub-GROUP –B (Adhesive Capsulitis):-

1) Sub-Group-B_1 –Standard Treatment ONLY:- ROM exercise, avoidance of exacerbating conditions such as use of Swath-type sling and over stretching exercise, proper limb positioning, management of underlying spasticity, and use of analgesic i.e. Tab Paracetamol 1gm t.i.d for 2 wks.

2) Sub-Group-B_2- Standard Treatment + High intensity TENS (*intensity-50mA, frequency 1-5Hz, and pulse width 150µs for 30 minute per day for4wks*)

Management Protocol for Sub-GROUP – C (Rotator Cuff Tendinitis):-

1) Sub-Group-C_1 – Standard Treatment ONLY: - Managed by maintaining scapular mobility, use of proper technique during stretching, treating spasticity, and when possible strengthening of internal and external rotator of the shoulder, Reduction of level of inflammation, and analgesic i.e., Tab Paracetamol 1gm t.i.d for 2 wks.

2) Sub-Group-C_2 – Standard Treatment + High intensity TENS (*intensity-50mA, frequency 1-5Hz, and pulse width 150µs for 30 minute per day for4wks*)

III. Results Analysis

Data was entered in Microsoft Excel and subsequently and analyzed by STATISTICA version 6 (Stats soft inc., Tulsa, Oklahoma, 2001), statistical software. Data has been summarized by usual descriptive measures that are mean, standard deviation, median and inter quartile range. Numerical variables were non-parametric and have been compared between two groups by Mann-Whitney U-Test while categorical variables have been compared by Chi-Square Test or Fisher's Exact Test as appropriate. Friedman's ANOVA was used to assess change in scores over time followed by Wilcoxon's Matched Pairs Signed Rank Test for assessing difference between any two time points. All analysis has been two-tailed. $p<0.05$ has been taken to be statistically significant. Out of the 114 patients 7 patients from different groups dropped out during study period (3 patients from Subluxation, 2 patients from Adhesive Capsulitis and 2 patients from Rotator Cuff Tendinitis group). Another 14 patients of the study population were rare presentation group of different etiology and also small in no (Statistically insignificant) and so, were excluded from the statistical analysis. They were distributed as 5 patients of CRPS, 4 patients of Bicipital Tendinitis, 3 patients of Bursitis and 2 patients of central pain syndrome. Rest of the 93 patients of our study population presented with hemiplegic shoulder pain was divided

into subluxation, adhesive capsulitis & rotator cuff tendinitis group. They were significant in number in each group and were presented for statistical analysis.

Age & Sex Distribution: The minimum age of presentation is 45 yrs and maximum age of presentation is 86 yrs. The mean age for Subluxation 64.93yrs with S.D 9.45, mean age of 66.58 for Adhesive Capsulitis with S.D 6.29.and mean age for Rotator cuff Tendinitis is 69.67 with S.D 9.26.The males clearly outnumbered the female in our study population with patient of HSP syndrome. However the male: female distribution is comparable between the three groups.

Distribution of Affected Side: left shoulder joint involvement is more commonly seen in case of patients with shoulder joint Subluxation and in patients of Adhesive Capsulitis. But reverse is seen in patients with Rotator Cuff Tendinitis, where right shoulder joint involvement is more than the left shoulder joint.

Distributions of time/days since onset of appearance of pain and 1st visit: in case of Subluxation minimum time of onset of beginning of pain to 1st visit is 10 days and maximum time of beginning of pain to 1st visit is 49 days with mean of 29.05± 9.44 after onset of stroke, in case of Adhesive Capsulitis it is minimum of 12 days and maximum of 56 days, with mean of 29.30±9.45,and in case of Rotator Cuff Tendinitis it is minimum of 10 days and maximum of 45 days, with a mean of 30.39±13.10.
From the above presentation it is clearly evident that there is wide range of time in presentation for seeking treatment of HSP since the incidence of stroke.

Distribution of Etiology of HSPS: Data shows that Subluxation is the most predominant cause (39%) in Hemiplegic shoulder pain syndrome, whereas Adhesive Capsulitis 31%, Rotator Cuff Tendinitis 17% and CRPS & Bicipital tendinitis share each of 4% of our study population.

SHOULDER PAIN AND DISABILITY INDEX (SPADI): following parameters of the scale were assessed from visit 1 (V_1) through visit 3(V_3) to all group of patients included in statistical analysis;

IV. Discussion

TENS is a supportive tool to alleviate pain & prevent disability due to HPSSP after stroke. The underlying mechanisms of TENS efficiency may rely on pain control and spasticity reduction actions. Leandri et al. [(18)] evaluated the effectiveness of high intensity versus low intensity transcutaneous electrical nerve stimulation (TENS) versus placebo for patients with hemiplegic shoulder pain. Low intensity TENS involves electrical stimulation just above the level of the skin sensory threshold. High intensity TENS is sufficient to elicit muscle contraction and an almost painful sensation. In our study we found that patients who received high intensity TENS had significant improvements in passive range of motion for flexion, extension, abduction, and external rotation at the shoulder. **In our study** is revealed that patients who received high intensity TENS also reported very satisfactory pain relief. Lack of definition and strict diagnostic criteria for the different painful shoulder conditions, valid randomization procedures, blinding, valid scales for outcome measurement, and heterogeneous populations are among the reasons for the difficulty to draw firm conclusions about the efficacy of any of these interventions. **In our study** it is noted that there is wide range of variation in presentation in age group from minimum of 45 yrs to maximum of 86 yrs of age with a mean age for subluxation 64.93yrs with S.D 9.45, mean age of 66.58 for adhesive capsulitis with S.D 6.29 and mean age for rotator cuff tendinitis is 69.67 with S.D 9.26. The males clearly outnumbered the female **in our study** with patients of HPSSP syndrome. According to Aras et al [(14)] high incidence of shoulder pain is seen in stroke patient with older age group. **In our study** the patients presented to us were in the 7th decade of their life and it corroborated with the findings of the previous observers. IKAI T. et al. [(15)] also concluded in their study that the shoulder joint pain was significantly more frequent in left sided hemiplegia. The probable explanation of the cause is that the patients with left hemisphere of brain involvement due to stroke were excluded due to their inability of communication following aphasia. In our study left shoulder joint involvement is more commonly seen in case of patient with shoulder joint subluxation and in patients of adhesive capsulitis but reverse is seen in patient with rotator cuff tendinitis, where right shoulder joint involvement is more than left. Poduri et al. [(12)] concluded that HPSSP precipitates 2 weeks to 3 Months after stroke but as early as 1st Week. This overall wide range of variation in the time of feeling of pain sensation in affected shoulder joint was also seen **in our study** e.g. in case of subluxation minimum time of onset of beginning of pain to 1st Visit is 10 days and maximum time of beginning of pain to 1st Visit is 49 days with mean of 29.05± 9.44 after onset of stroke, in case of adhesive capsulitis it is minimum of 10days and maximum of 56 days, with mean of 29.30±9.45,and in case of rotator cuff tendinitis it is minimum of 12 days and Maximum of 45 days, with a mean of 30.39±13.10. Similar observation was reported by Lindgren et al. (2007) that, approximately half of the HPSSP patients developed pain between stroke onset

and 4 months. Similarly in our study we noted the most common contributing factors of hemiplegic shoulder pain syndrome are subluxation of glenohumeral joint 39%, adhesive capsulitis 31%, rotator cuff tendinitis17% and CRPS 4% as per decreasing order of frequency. Diabetes Mellitus identified as a predictor of shoulder pain. The conservative management of hemiplegic shoulder pain by different type of rehabilitative management includes therapeutic modalities, like proper positioning of the affected shoulder joint as per different stages of involvement. Proper positioning not only reduces chance of shoulder pain but also promotes smooth recovery. Gilmore et al. (2004) and Davis (2000), [(16)] concluded that, a careful and correct positioning can prevent development of pain in affected shoulder joint. **During our study** period all patients on 1st visit were suggested to maintain specific limb positioning as per the standard evidence and instruction of Text Book of Physical Medicine & Rehabilitation. Appropriate exercise program have substantial role in management of shoulder pain in stroke patients. Role of specific exercise has been established in case of different etiologies of shoulder pain. Many physical therapeutic resources like, hot pad, Cryotherapy, Ultrasound therapy, FES, NMES, TENS are studied in Shoulder pain patient with hemiplegia. No single modality is seen to be superior to other. Leandri et al. [(28)] reported that patients who received high intensity TENS had significant improvement in passive range of motion for flexion, extension, abduction and external rotation of the shoulder than with low intensity TENS. **In our study** we have chosen TENS being proven modality in treatment of acute & chronic persistent pain including in HPSSP, being low in cost, easy in availability, with no known potential side effects for overdose, and easy to use after demonstration to care giver. It also can be used as a home based treatment modality subject to affordability. **In our study high intensity TENS** given to patient of shoulder pain with Gleno-Humeral Joint subluxation, adhesive capsulitis, and rotator cuff tendinitis. **In our study we found** that TENS had significantly improved the pain score of SPADI in patients with subluxation after 2nd visit with a statistical significant result with P-value of <0.001 after 12 wks of treatment, with a similar improvement seen in adhesive capsulitis with statistical significance of P-value0.023 in 3rd visit. But it fails to show significant improvement in cases of rotator cuff tendinitis with HPSP. **In our study** we found insignificant improvement of disability score in SPADI scale noted in patient of adhesive capsulitis and rotator cuff tendinitis, but our study showed significant improvement in SPADI disability score in subluxation patient with P-value of 0.001 and the total SPADI score P-value <0.001 after 12 wks of treatment. Lendri et al[(18)] also found the patients who received high intensity TENS had significant improvement in passive range of motion for flexion, extension, abduction and external rotation at the shoulder.

V. Conclusion

From our study it can be concluded that most of the patients with hemiplegic shoulder pain syndrome who are presented in the 7th decade of their life with the mean age of 64.93 for subluxation of shoulder joint, 66.58 for adhesive capsulitis, and 66.67 for rotator cuff tendinitis with a male preponderance over the female in HPSP syndrome. There is left shoulder joint involvements more common than the right shoulder joint involvement. But right shoulder joint are mostly affected in case of rotator cuff tendinitis. Most of the patients are presented after 10 days to 56 days after the onset of pain. Patients were presented from 22days to maximum of 133 days from the onset of stroke. Subluxation of the shoulder joint is the major etiology of shoulder pain followed by adhesive capsulitis, rotator cuff tendinitis, CRPS, bicipital tendinitis. Physical modalities are helpful for improvement of pain score at later part of treatment period in the study population of subluxation and adhesive capsulitis with subsequently P-value of < 0.001 and 0.023. Improvement of disability score due to physical therapy was seen significantly in subluxation with P-value of 0.001.Physiatric management did not show statistically significant improvement of SPADI score of the patient with adhesive capsulitis and rotator cuff tendinitis, but there is definite improvement of SPADI score of subluxation with statistical significance (P value < 0.05). As per the statistical calculation range of motion of shoulder joint improves in all the three groups, but the improvement pattern is statistically significant only in case of hemiplegic shoulder joint with subluxation.

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TABLE-01: Total SPADI Score Comparison

		SUBLUXATION			ADHESIVE CAPSULITIS			ROTATOR CUFF TENDINITIS		
		Rx1	**Rx2**	**P-value**	**Rx1**	**Rx2**	**P-value**	**Rx1**	**Rx2**	**P-value**
SPADI-1	Range	102-130	103-130	.456	99-130	99-130	.245	120-130	116-130	.489
	Mean±SD	119.61 ±7.18	118.14 ±7.32		116.1±8.91	119.4 ±8.86		124.4 ±3.43	122.5 ±4.53	
	Median (IQR)	121(114-123)	120 (113-123)		118(109-123)	121(112-126)		125 (122-127)	123(121-125)	
SPADI-2	Range	91-121	93-118	.016	93-130	91-128	.790	107-123	103-130	.605
	Mean ±SD	109.09±7.34	103.9 ±6.66		111.3 ±11.43	110.7±10.99		115.5 ±6.28	114.5 ±10.15	
	Median (IQR)	109(105-114)	103 (98-107)		112 (102-120)	114(102-118)		114 (110-121)	113 (106-118)	
SPADI-3	Range	88-117	76-118	<0.001	86-130	86-124	.382	98-128	88-130	.190
	Mean ±SD	101±7.09	90.5 ±9.8		106 ±12.2	102 ±10.38		107.4 ±11.45	103.2 ±18.55	
	Median(IQR)	101(96-105)	89 (84-96)		105 (96.5-115.5)	105 (91-107)		103 (100-107)	93 (89-123)	

(P-value has been obtained from comparison between groups by Mann-Whitney U-Test)

N.B. From Table-01, it is evident that standard treatment with TENS improves SPADI score in all groups but statistically significant improvement is noted in Subluxation patients.

TABLE – 02: SPADI Pain Score Comparison

		SUBLUXATION			ADHESIVE CAPSULITIS			ROTATOR CUFF TENDINITIS		
		Rx1	**Rx2**	**P-value**	**Rx1**	**Rx2**	**P-value**	**Rx1**	**Rx2**	**P-value**
P1	Range	**37-50**	38-50	.950	37-50	34-50	**.901**	45-50	42-50	**.796**
	Mean±SD	45.09±3.60	45.14±33.16		43.8±4.36	43.8±5.37		47.2± 1.92	47.2± 2.58	
	Median(IQR)	45(43-48)	45(43-48)		43.5(40-47)	45(40-49)		47 (46-47)	48 (46-49)	
P2	Range	33-45	33-45	.056	32-50	27-49	**.309**	37-47	36-50	.796
	Mean±SD	40.33±2.92	38.71±3.27		41.2±5.22	39.05±6.34		42.4± 4.06	42.2± 5.51	
	Median(IQR)	41(38-42)	38(37-40)		41(37-45)	41(35-45)		42 (39-46)	43 (37-45)	
P3	Range	32-41	27-47	.000	31-50	24-47	**.023**	34-49	31-129	.605
	Mean±SD	37.0±2.78	33.0±4.30		39.1±5.63	33.7±5.99		39.3 ± 5.67	48.1±31.41	
	Median(IQR)	38(36-39)	32(31-34)		39(35-44)	35(28-38)		38 (35-40)	33 (32-50)	

(P-value has been obtained from comparison between groups by Mann-Whitney U-Test)

N.B. From Table-02, it has been revealed that TENS shows statistical significant in both subluxation and adhesive capsulitis but mild improvement in rotator cuff tendinitis.

TABLE-03: SPADI Disability Score Comparison

		SUBLUXATION			ADHESIVE CAPSULITIS			ROTATOR CUFF TENDINITIS		
		Rx1	Rx2	P-value	Rx1	Rx2	P-value	Rx1	Rx2	P-value
D1	Range	65-80	65-80	.300	61-80	64-80	.118	74-80	70-80	.113
	Mean±SD	74.5 ±3.91	73-4.74		72.3 ±5.16	75 ±4.63		77.2 ±1.98	75.3 ±2.69	
	Median (IQR)	75 (72-77)	75 (69-76)		73 (68-77)	76 (72-79)		77 (76-79)	76 (74-76)	
D2	Range	58-78	57-76	.025	56-80	63-79	.533	68-76	66-80	.605
	Mean±SD	68.7 ±4.97	65.2 ±4.70		70.1 ±6.74	71.6 ±5.21		73.1 ±2.84	72.3 ±5.45	
	Median (IQR)	67 (62-67)	65 (61-68)		69.5 (65-75)	73 (67-76)		74 (72-76)	72 (68-75)	
D3	Range	56-76	48-71	.001	53-80	61-77	.533	62-79	57-80	.222
	Mean±SD	64.2 ±4.89	57.5 ±6.30		66.8 ±7.02	68.2 ±5.03		68.1 ±6.23	65.8 ±10.24	
	Median (IQR)	63 (62-67)	55 (53-63)		66.5 (62-72)	70 (63-72)		65 (65-69)	61 (58-78)	

(P-value has been obtained from comparison between groups by Mann-Whitney U-Test)

N.B. From Table-03, the statistical data shows variable disability improvement in all groups of patients but statistically significant improvement is noted in subluxation.

Dr. Tushar Kanti Saha.et.al. "Prospective study on Beneficial Effects of High Intensity TENS in the Process of development and recovery of Post Stroke Hemiplegic Shoulder Pain."*IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 19(1), 2020, pp. 49-56.