

## **-Intervention Protocol**

**Study Name: Effect of Optimal Movement, Stretching and Strengthening Exercise to Prevent Shoulder Pain of Paraplegic Spinal Cord Injury Patient.**

**Objectives:**

### **Primary object**

To determine and compare the effect of optimal movement, stretching and strengthening exercises with usual care to prevent shoulder pain of paraplegic spinal cord injury patients in a rehabilitation center of Bangladesh.

### **Secondary objective**

To investigate (1) the relationship of shoulder pain during functional activities (WUSPI score) with muscle strength of shoulder (MMT score); (2) evaluate the relationship of neurological classification (AIS-A, AIS-B, AIS-C) with shoulder pain during functional activities (WUSPI score). The study hypothesis that the, optimal movement, stretching and strengthening exercises are more effective than usual care in preventing shoulder pain of paraplegic spinal cord injury patients.

### **Ethical approval:**

This study has approved form International Review Board (IRB), BHPI, **CRP(CRP/BHPI/IRB/06/2020/393)** and Clinical Trial Registry India (CTRI) (**CTRI/2020/06/025628**).

### **Hypothesis**

#### **Alternative hypothesis (H<sub>1</sub>):**

Optimal movement, stretching and strengthening exercises are more effective than usual care in preventing shoulder pain of paraplegic spinal cord injury patient.

$\mu_1 - \mu_2 \neq 0$  or  $\mu_1 \neq \mu_2$ , where the experimental group and the control group initial and final mean difference is not same

**Null hypothesis (Ho):**

Optimal movement, stretching and strengthening exercises are no more effective than usual care in preventing shoulder pain of paraplegic spinal cord injury patient.

$\mu_1 - \mu_2 = 0$  or  $\mu_1 = \mu_2$ , where the experimental group and control group initial and final mean difference is same.

**Participants**

All spinal cord injury patients who was admit with spinal cord injury at Centre for the Rehabilitation of the Paralyzed (CRP), Savar in a study period was consider as a participants of this study.

**Eligibility criteria:****Inclusion**

- (1) Paraplegic SCI (Razzak, Roy, & Khan, 2016).
- (2) Both males and females (Chowdhury, Barua, Uddin, Khatun, & Biswas, 2015).
- (3) Age above 16years (Razzak et al., 2016).
- (4) ASIA A, B, and C grade and predicted that they will permanently depend on a wheelchair for moving long distances (Eriks-Hoogland et al., 2016).
- (5) Participants using a wheelchair for one week and can independently sit for 3-4 hour.
- (6) Participants who have no history of shoulder pain.
- (7) Willing to participate.

**Exclusion**

- (1) History of shoulder pain, able to walk; and head injury because they might be not able to communicate properly (Hossain et al., 2016).
- (2) Systemic disease and previous trauma to the shoulder (Azadvari, Razavi, Tavasol, & Rkhsan, 2019).

(3) Taking treatment for any psychiatric disorder before getting spinal cord injury (Wang et al., 2015).

(4) Already participated in another research study.

(5) Unwilling to participate.

**Treatment provider:**

Physiotherapists who were an expert in treatment of Spinal cord injury patients were involved in treatment.

**Qualification of treatment provider:**

Graduate physiotherapist, diploma physiotherapist, physiotherapy assistant who has the experience of working more than 2 years in the spinal cord injury department was selected as a treatment provider. Written instructions of optimal movement were provided to patient by two intern physiotherapist. Before starting treatment, training session was arranged by researcher. Weekly evaluation of intervention provider was done by a senior physiotherapist.

**Conventional treatment:**

Conventional treatment protocol was prepared by interview with 5 qualified physiotherapists. Therapists recommend the treatments which they use regularly for their patients.

Codes	Intervention	Dosage	Pt-1	Pt-2	Pt-3	Pt-4	Pt-5
<b>Exercises</b>							
C-1	Anterior shoulder joint stretching	10-20 repetitions/ 2-4 sets	√	√	√	√	√
C-2	Posterior shoulder joint stretching.	10-20 repetitions/ 2-4 sets	√	√	√	√	√
C-3	Strengthening exercise by	10-20 repetitions/	√√	√√	√√	√√	√√

	using dumble.	1-4 sets					
C-4	Strengthening exercise by using resistance band	10-20 repetitions/ 1-4 sets	√	X	√	X	√
<b>Advice</b>							
C-6	Use appropriate wheelchair		√√	√√	√√	√√	√√
C-7	During transferring avoid extreme movement.		√	X	X	X	X

**Intervention protocol:**

<b>Code</b>	<b>Intervention</b>	<b>Author</b>
<b>Stretching exercises</b>		
E-1	<b>Upper trapezius:</b> For upper trapezius stretching patient was in sitting position at W/C, therapist stabilize the patient trunk by one hand, and by the other hand gently bend the head (avoid rotation) to opposite side (Figure-1).	(Nawoczenski, Ritter-Soronen, Wilson, Howe, & Ludewig, 2006)
E-2	<b>Pectoralis muscle:</b> In sitting position therapist was instructed the patient to place their forearm on a stable object, and elbow was kept below 90°. Then patient was instructed to rotate the W/C away from the stable object (Figure-2).	
E-3	<b>Long head the biceps muscle:</b> Patient's W/C was place with the stable object. Arm was slightly abducted, forearm on stable object. Then patient was instructed to rotate the chair away from the stable object. Try to maintain the scapular retraction and depression during stretch (Figure-3).	
E-4	<b>Posterior capsule:</b> Patient was in lying position between supine and side lying the on the side to be stretched to stabilize the scapula. Pillow or roll towel was placed under the opposite scapula. Then the patient stretches the arm across the body with the opposite hand (avoid shoulder rotation). (Figure: 4)	
<b>Strengthening exercises</b>		
E-5	<b>Middle and lower trapezius muscles (Method -1):</b> Patient was in sitting posture. Therapist instruct the patient to do slight abduction of shoulder and external rotation, squeeze shoulder blade in downward direction and together (exercise was progress to shoulder rotation exercise with	(Nawoczenski, Ritter-Soronen, Wilson, Howe, & Ludewig, 2006)

	resistance band) (Figure-5).	
E-6	<b>Middle and lower trapezius muscles (Method-2):</b> Patient was in supine lying position. Instruct the patient to keep arm approximately in 45° of abduction and squeeze the shoulder blades together and downward direction (Figure-6).	
E-7	<b>Serratus anterior muscles:</b> Tied the resistance band to the back of the wheelchair. Shoulder blade squeeze together and downward followed by punch the arm forward (Figure-7).	
E-8	<b>Shoulder external rotator:</b> Between the trunk and arm placed a towel in both side. Elbow was 90° hand grasped resistance band. Shoulder blades squeezed down and together followed by slow pulling of hand apart. (Figure: 8)	
<b>Optimal movement (OM) recommendation</b>		
<b>OM-1:</b> <b>Recommendation</b> of transfer and raise modification	<ul style="list-style-type: none"> <li>a. If possible, try to adjust the height to make the transfer surfaces equal.</li> <li>b. If possible, try to make the target surface lower by adjusting height.</li> <li>c. During transferring try to avoid extreme position or movement.</li> <li>d. If possible, lead with the painful shoulder (if pain present).</li> <li>e. Use a sliding board if necessary during transfer and bring the transfer surfaces closer.</li> <li>f. Keep the arms /hands on the transfer surfaces instead of placing above shoulder height/ grasping overhead objects during transfer.</li> </ul>	Mulroy et al. (2011)

	<p>g. Use ordered height (e.g. stool/cushion) during transfer from lower to higher surface.</p>	
<p><b>OM-2:</b> Recommendations for wheelchair propulsion modification</p>	<p>a. Instead of short and repeated strokes, try to use long and smooth strokes during wheelchair propulsions.</p> <p>b. To avoid fast change of arm direction, at the time of finishing push stroke allow your hand to drift downward.</p> <p>c. Avoid fast and forceful effects on the pushrim.</p> <p>d. Rough/ uneven ground should be avoided.</p> <p>e. When you push on rough ground for a long distance, stop and take rest.</p> <p>f. Avoid vertical slopes when possible.</p> <p>g. After pushing on a long distance, if your arms get tired, stop and take rest.</p>	<p>Mulroy et al. (2011)</p>

**Stretching exercises:**



**Figure-1: Upper trapezius stretching**



**Figure- 2: Pectoralis major muscle stretching**



**Figure- 3: long head of biceps stretching**



**Figure-4: Posterior capsule stretch**

**Strengthening exercises:**



**Figure-5: Middle and lower trapezius muscle strengthening (Method 1)**



**Figure-6: Middle and lower trapezius muscle strengthening (Method 2)**



**Figure-7: Serratus anterior muscle strengthening**



**Figure-8: Shoulder external rotator strengthening**

### **Usual care (UC) for both groups:**

UC were provided to make the patient as independent as possible. Treatment was depends on patients ability.

- Pain management (proper positioning by using appropriate support and device, mobilization, transverse friction massage, hot and cold compression and many other electrical modalities like TENS, IRR, UST etc.)
- Spasticity management- positioning, stretching, weight bearing exercise, using assistive device etc.
- Active, active assisted, passive and accessory Range of Motion exercise
- Strengthening exercise (Active, active resistive, isometric, isokinetic, Active weight bearing exercise, and use various equipment of therapeutic gym-such as static cycle, CPM.)
- Sitting balance practice- static and dynamic
- Encourage to functional activities according to his/her neurological level
- Transferring Practice- high to low transferring, low to high transferring, slide board and cloth transferring etc.
- Sit to stand practice (advance such as floor/low level Standing balance and standing practice- static and dynamic).
- Wheel chair skill training.

**Treatment Progression:**

	Week 1		Week 2		Week 3		Week 4		Week 5		Week 6		Week 7		Week 8	
<b>F r e q u e n c y</b>	Day 1-3	Day 4-6	Day 1-3	Day 4-6	Day 1-3	Day 4-6	Day 1-3	Day 4-6	Day 1-3	Day 4-6	Day 1-3	Day 4-6	Day 1-3	Day 4-6	Day 1-3	Day 4-6
<b>T y p e s</b>	C1+C6+C7 +E1+ UC+ Advice (C6, C7)	C1+ C2+ E1+ E2+ UC	C1+C 2+C3+ E1+E2 +E5+ UC	C1+C2 +C3+E 1+E2+ E5+E6 +UC	C1+C2 +C3+E 1+E2+ E5+E6 +UC	C1+C 2+C3 +E1+ E2+E 3+ E5+E 6+E7 +UC	C1+C 2+C3 +E1+ E2+E 3+ E5+E 6+E7 +UC	C1+C 2+C3 +E1+ E2+E 3+ E5+E 6+E7 +UC	C1+C2 +C3+ C4+E1 +E2+E 3+ E5+E6 +E7+E 8+UC	C1+C2 +C3+ C4+E1 +E2+E 3+ E5+E6 +E7+E 8+UC	C1+C2 +C3+ C4+E1 +E2+E 3+ E5+E6 +E7+E 8+UC	C1+C2 +C3+ C4+E1 +E2+E 3+ E5+E6 +E7+E 8+UC	C1+C2 +C3+ C4+E1 +E2+E 3+ E5+E6 +E7+E 8+UC	C1+C2 +C3+ C4+E1 +E2+E 3+ E5+E6 +E7+E 8+UC	C1+C2 +C3+ C4+E1 +E2+E 3+ E5+E6 +E7+E 8+UC	C1+C2 +C3+ C4+E1 +E2+E 3+ E5+E6 +E7+E 8+UC
<b>I n t e n s i t y</b>	E1=10 repX1 set (hold 20sec +rest 15sec)	E1, E2= 10re pX1 set (hold 20sec+ rest 15sec) E5= E6=	E1, E2=10 repX 2sets (hold 20sec+ rest 15sec) E5= E6=	E1, E2=10r epX2se t (hold 20sec+r est 15sec) E5, E6=	E1, E2, E5, E6= No change	E1, E2=1 0repX 3set (hold 20sec +rest 15sec )	E1, E2, E3= E2=1 0repX 3sets (hold 20sec +rest 15sec )	No chang e	E1, E2, E3= =10rep X3sets (hold 20sec+ rest 15sec)	E1, E2, E3 = 10 rep X 3sets (hold 20sec, rest 15sec)	E1, E2, E3, E4 = 10 rep X 3sets (hold 20sec, rest	E1, E2, E3, E4= no change E5, E6, E7= no	No change	E5, E6, E7=10 rep X 3sets (35-40 sec hold) E8	E5, E6, E7, E8 -10rep x3sets (hold4 0 -	No change

		st 15sec c)	10rep X 1set (hold 10sec)	10rep X 2sets (hold 10sec)		E3= 10rep X2set (hold 20sec +rest 15sec ) E5, E6= 10rep X 2set (hold 20sec ) E7= 10rep X 2set (hold 10sec )	15sec ) E5, E6, E7= 10rep X3set (hold 20 sec)		E5, E6, E7= 10rep X 3set (hold 25-30 sec)  E8= 10rep X 2set (hold 10-15 sec)	E4= 10rep X 2set (hold 20sec+ rest 15 sec)  E5, E6, E7 = 10re X 3set (hold 30- 35sec)  E8 10rep X 2set (hold 15- 20sec)	15sec)  E5, E6, E7 = 10rep X 3set (hold 35sec)  E8 = 10rep X 2set (hold 20- 30sec)	change E8= 10 rep X 3set (hold 20- 30sec)		10rep X 3set (hold 30- 35sec)	45sec )			
<b>T i m e</b>	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day	1time/day

**Advice (optimal movement) follow up checklist:**

<b>Participants Serial No.</b>	<b>Week 1</b>	<b>Week 2</b>	<b>Week 3</b>	<b>Week 4</b>	<b>Week 6</b>	<b>Week 7</b>	<b>Week 8</b>
<b>E1</b>	√	√	√	√	√	√	√
<b>E2</b>	√	√	√	√	√	√	√
<b>E3</b>	√	√	√	√	√	√	√
<b>E4</b>	√	√	√	√	√	√	√
<b>E5</b>	√	√	√	√	√	√	√
<b>E6</b>	√	√	√	√	√	√	√
<b>E7</b>	√	√	√	√	√	√	√
<b>E8</b>	√	√	√	√	√	√	√
<b>E9</b>	√	√	√	√	√	√	√
<b>E10</b>	√	√	√	√	√	√	√
<b>E11</b>	√	√	√	√	√	√	√
<b>E12</b>	√	√	√	√	√	√	√
<b>E13</b>	√	√	√	√	√	√	√
<b>E14</b>	√	√	√	√	√	√	√
<b>E15</b>	√	√	√	√	√	√	√
<b>E16</b>	√	√	√	√	√	√	√
<b>E17</b>	√	√	√	√	√	√	√
<b>E18</b>	√	√	√	√	√	√	√
<b>E19</b>	√	√	√	√	√	√	√
<b>E20</b>	√	√	√	√	√	√	√
<b>E21</b>	√	√	√	√	√	√	√
<b>E22</b>	√	√	√	√	√	√	√
<b>E23</b>	√	√	√	√	√	√	√
<b>E24</b>	√	√	√	√	√	√	√
<b>E25</b>	√	√	√	√	√	√	√
<b>E26</b>	√	√	√	√	√	√	√

<b>E27</b>	√	√	√	√	√	√	√
<b>E28</b>	√	√	√	√	√	√	√
<b>E29</b>	√	√	√	√	√	√	√
<b>E30</b>	√	√	√	√	√	√	√
<b>E31</b>	√	√	√	√	√	√	√
<b>E32</b>	√	√	√	√	√	√	√
<b>E33</b>	√	√	√	√	√	√	√
<b>E34</b>	√	√	√	√	√	√	√
<b>E35</b>	√	√	√	√	√	√	√
<b>E36</b>	√	√	√	√	√	√	√
<b>E37</b>	√	√	√	√	√	√	√
<b>E38</b>	√	√	√	√	√	√	√
<b>E39</b>	√	√	√	√	√	√	√
<b>E40</b>	√	√	√	√	√	√	√

**Adverse Event:**

<b>Participants Serial No.</b>	<b>Week 1</b>	<b>Week 2</b>	<b>Week 3</b>	<b>Week 4</b>	<b>Week 6</b>	<b>Week 7</b>	<b>Week 8</b>
<b>E1</b>	X	X	X	X	X	X	X
<b>E2</b>	X	X	X	X	X	X	X
<b>E3</b>	X	X	X	X	X	X	X
<b>E4</b>	X	X	X	X	X	X	X
<b>E5</b>	X	X	X	X	X	X	X
<b>E6</b>	X	X	X	X	X	X	X
<b>E7</b>	X	X	X	X	X	X	X
<b>E8</b>	X	X	X	X	X	X	X
<b>E9</b>	X	X	X	X	X	X	X
<b>E10</b>	X	X	X	X	X	X	X
<b>E11</b>	X	X	X	X	X	X	X
<b>E12</b>	X	X	X	X	X	X	X
<b>E13</b>	X	X	X	X	X	X	X
<b>E14</b>	X	X	X	X	X	X	X
<b>E15</b>	X	X	X	X	X	X	X
<b>E16</b>	X	X	X	X	X	X	X
<b>E17</b>	X	X	X	X	X	X	X
<b>E18</b>	X	X	X	X	X	X	X
<b>E19</b>	X	X	X	X	X	X	X
<b>E20</b>	X	X	X	X	X	X	X
<b>E21</b>	X	X	X	X	X	X	X
<b>E22</b>	X	X	X	X	X	X	X
<b>E23</b>	X	X	X	X	X	X	X
<b>E24</b>	X	X	X	X	X	X	X
<b>E25</b>	X	X	X	X	X	X	X
<b>E26</b>	X	X	X	X	X	X	X
<b>E27</b>	X	X	X	X	X	X	X

<b>E28</b>	X	X	X	X	X	X	X
<b>E29</b>	X	X	X	X	X	X	X
<b>E30</b>	X	X	X	X	X	X	X
<b>E31</b>	X	X	X	X	X	X	X
<b>E32</b>	X	X	X	X	X	X	X
<b>E33</b>	X	X	X	X	X	X	X
<b>E34</b>	X	X	X	X	X	X	X
<b>E35</b>	X	X	X	X	X	X	X
<b>E36</b>	X	X	X	X	X	X	X
<b>E37</b>	X	X	X	X	X	X	X
<b>E38</b>	X	X	X	X	X	X	X
<b>E39</b>	X	X	X	X	X	X	X
<b>E40</b>	X	X	X	X	X	X	X