

# Synergistic Effects of Manual Therapy, Neuromuscular Training and Virtual Reality in Cervical Radiculopathy: A Case Report

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## ABSTRACT

Cervical radiculopathy is a common condition that typically occurs as a result of nerve root or roots compression and inflammation in the region of the neural foramen. The encroachment normally causes neck and radiating arm pain or paresthesias, sensory impairment, or motor dysfunction in the upper extremities and neck. Hereby, the authors present a case report of a 37-year-old female with cervical radiculopathy. She complains of neck and shoulder joint pain, radiating down to left arm till elbow joint. On observation she had forward head posture and on examination reduced mobility of cervical region and shoulder joint with reduced strength of scapular muscle. This comprehensive rehabilitation strategy incorporates multiple evidence-based technique uses, including Mulligan mobilisation, neural tissue mobilisation, Scapular mobilisation, Sahrman Exercise and virtual reality. Range of motion, Pain, and Muscle strength were the primary outcome measures. Neck Disability Index (NDI) was also assessed. The four week rehabilitation protocol has shown positive outcomes that highlight reduction in pain, improved mobility, increased muscle strength, correction of faulty posture, restored functions, and enhanced overall well-being. However, further clinical studies are necessary to evaluate the combined efficacy of these interventions and to establish standardised protocols for their implementation.

**Keywords:** Rehabilitation, Mulligan mobilisation, Neck disability index, Sahrman exercise

## CASE REPORT

A 37-year-old female, diagnosed with cervical radiculopathy by an orthopaedician, was referred to the Physiotherapy Department. She was a housewife and worked 5-6 hours daily in the kitchen. She complains of neck pain lasting for three months, radiating down to the left arm for the past one month, which restricts movement in the neck and shoulder joints. The patient reported that she was initially fine three months ago but started experiencing neck pain while doing household chores. As the pain was mild, she ignored it until about 1.5 months ago, when she began feeling radiating pain in her left arm while cooking. She tried homemade remedies such as applying heat and medicated balms to alleviate the pain. One month ago, she visited a local hospital, where an X-ray was taken, and the orthopaedician diagnosed her with cervical radiculopathy, prescribed medications, and referred her for physiotherapy. She has no history of any co-morbidities or family history of a similar condition. On observation, she displayed forward head posture. Palpation revealed tenderness (Grade 1) [1] on C5, C6, and C7 cervical spinous processes, along with muscle spasm over the upper trapezius. During physical examination, she reported severe pain while moving her neck and left shoulder, with reduced scapular mobility. Using the Numerical Pain Rating Scale [2], she rated her pain as seven during activity and three at rest. Muscle examination showed tightness of the trapezius and levator scapulae muscles,

with reduced strength in the scapular muscles, deltoid, and biceps. Tests performed, including cervical compression and distraction [3] as well as the Upper Limb Tension Test (ULTT) [4] for the median and radial nerves, were positive.

## Intervention

A four-week protocol was followed for reducing the pain, improving mobility of nerves as well as joints, correcting the biomechanical alignment and overall well-being of the patient. The protocol given is well elaborated in [Table/Fig-1] [1,5]. Physiotherapist performing Mulligan mobilisation for cervical spine and demonstrating active range of motion exercises for cervical spine to the patient has been depicted in [Table/Fig-2,3].

Sahrman exercise is as follows

- Upper cervical flexion in supine with Chin tuck;
- Shoulder flexion in supine with Chin tuck;
- Shoulder Abduction and lateral rotation in supine with chin tuck;
- Supine upper cervical flexion with head lift with chin tuck;
- Sitting against the wall, upper cervical flexion with chin tuck;
- Sitting against the wall, cervical rotation with chin tuck;
- Sitting against the wall, shoulder flexion with chin tuck;

Goals	Intervention			
Patient education	Individual counselling of the patient and her relatives was done, where information regarding cervical radiculopathy: its aetiology, triggering factors, the importance of physiotherapy: its benefits, scope for improvement, precautions, and considerations was given.			
	Week 1	Week 2	Week 3	Week 4
To reduce pain	TENS- 15 min/day Mulligan mobilisation (C5-C6-C7)- 6 times a week [Table/Fig-2], Cyriax- 4 times/ week	TENS- 15 min/ 3 times a week Mulligan mobilisation(C5-C6-C7)-3 times a week on alternate days, Cyriax – 2 times/ week	Mulligan mobilisation (C5-C6-C7)- 2 times a week.	Mulligan mobilisation (C5-C6-C7)- 2 times a week.
To improve mobility of nerve	Neural tissue mobilisation for median and radial nerve- 4 times/ week	Neural tissue mobilisation for median and radial nerve- 2 times/week		

To optimise maximum movement	Cervical AROM exercises consisting of cervical flexion in pain free range), extension, rotations and side flexion- 10 reps x 2 set [Table/Fig-3] Shoulder AROM exercise- 10 reps x 2 set, Scapular mobilisation - 6 times a week Sahrmann exercise	Cervical AROM exercises- 10 repsx1 set Shoulder AROM exercise – 10 repsx1 set,  Scapular mobilisation - 3 times a week, Sahrmann exercise	Cervical AROM exercises- 10 repsx1 set  Scapular mobilisation - 2 times a week, Sahrmann exercise	Cervical AROM exercises- 10 repsx1 set Sahrmann exercise
To correct biomechanical alignment	PNF stretching (Contract-relax Technique) for Trapezius and Levator Scapulae, Virtual reality to correct forward head posture.	PNF stretching (Contract-relax Technique) and Virtual reality	PNF stretching (Contract-relax Technique) and Virtual reality	PNF stretching (Contract-relax Technique) and Virtual reality
To improve muscle strength	Scapular isometric in supine, Cervical isometrics 10 repsx1 set with 5 sec hold.	Cervical isometrics 10 reps x 1set with 10 sec hold. Shoulder resistance training exercise with 0.5 kg dumbbell- 10 repsx1 set	Muscle Energy Technique (MET) for cervical muscle -4 times a week, Scapular stabilisation (T,Y,W) exercises 10 repsx1 set, Shoulder resistance training exercise with 0.5 kg dumbbell- 10 repsx1 set with 5 sec hold.	MET for cervical muscle - 2 times a week, Scapular stabilisation exercises (T,Y,W) with 0.5 kg dumbbell – 10 repsx1 set, Shoulder resistance training exercise with 1 kg dumbbell 10 repsx1 set with 10 sec hold.
To prevent further injury damage	Ergonomic advice and precautions such as: Avoid lifting of heavy weight on head. Use thin pillow Avoid jerky or excessive movement of the neck The height of kitchen table and work station should be at elbow level			

[Table/Fig-1]: Four-week treatment protocol [1,5].

AROM: Active range of motion; PNF: Proprioceptive neuromuscular facilitation; TENS: Transcutaneous electrical nerve stimulation



[Table/Fig-2]: Physiotherapist performing Mulligan mobilisation for cervical spine.



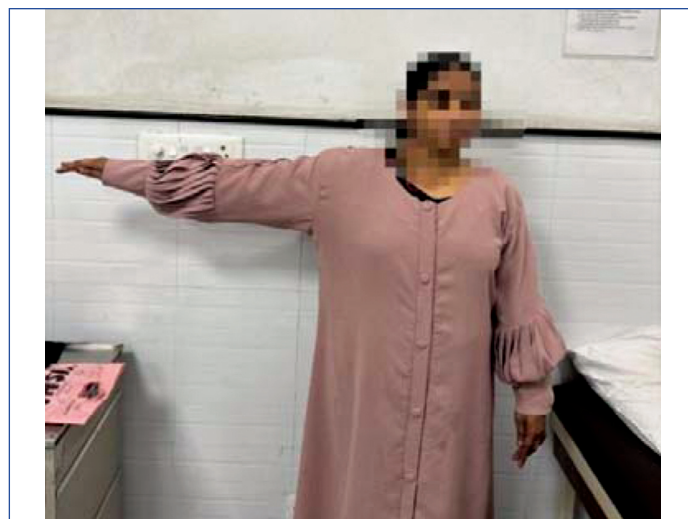
[Table/Fig-3]: Physiotherapist demonstrating AROM exercises for cervical spine to the patient.

- Standing against the wall, shoulder abduction and lateral rotation with chin tuck [Table/Fig-4];
- Facing the wall arm slide and scapula adduction with chin tuck;
- Facing the wall arm slide and cervical rotation with chin tuck;
- Prone, arm overhead with scapula adducted.

The patient resided in different city and was unable to visit for follow-up, moreover no telephonic follow-up was taken.

### Treatment Outcomes

In the study, the patient underwent a four-week protocol that showed positive results. Pain was reduced, Joint mobility was improved, and strength was increased. [Table/Fig-5] shows the difference in pre and post-treatment [6].



[Table/Fig-4]: Patient performing Sahrman exercise (Standing against the wall, shoulder abduction and lateral rotation with chin tuck).

The NDI was used as a outcome measure and the pre and post treatment values are given in [Table/Fig-6].

### DISCUSSION

A multimodal treatment protocol incorporating manual therapy, neuromuscular re-education, and technology-based interventions has greater synergistic advantages to treat cervical radiculopathy. This section is a review of the synergistic effects of Mulligan mobilisation, neural tissue mobilisation, PNF stretching, Sahrman exercises, and virtual reality based rehabilitation.

The patient demonstrated relief from pain immediately post-mulligan mobilisation. Anandkumar S, in his case study on the patient of cervical radiculopathy, discovered similar positive outcomes and gave a rationale to the technique in terms of biomechanical explanation. The repositioning of the superior articular facet with an Sustained Natural Apophyseal Glides (SNAGs) corrected the positional fault, leading to less pain and more ROM in neck [7]. Also, normal movement of the articular surface is required for maintaining the mobility of the adjacent nerves where changed biomechanics can influence the nerve's excursion.

Neural tissue mobilisation is specifically aimed at the restoration of nerve mobility, neural flexibility, and ROM. Neural mobilisation enhances intraneural circulation, which improves axoplasmic flow, therefore enhancing neural connective tissue visco-elasticity and

Variables			Pre-treatment	Post-treatment (immediately post 4 weeks)
Pain	NPRS		7/10 - on activity 3/10- on rest	2/10 - on activity 0/10- on rest
			<b>Left-side</b>	<b>Left-side</b>
Range of motion	Cervical Joint- using CROM Device	Cervical flexion	0°-52°	0°-78°
		Cervical extension	0°-40°	0°-66°
		Cervical side flexion	0°-32°	0°-41°
		Cervical rotation	0°-58°	0°-85°
	Shoulder joint- using goniometer	Shoulder flexion	0°-165°	0°-175°
		Shoulder extension	0°-35°	0°-60°
		Shoulder abduction	0°-155°	0°-170°
	Elbow joint- using goniometer	Elbow flexion	0°-140°	0°-140°
Elbow extension		140°-0°	140°-0°	
Muscle strength	Manual Muscle Testing (MRC Grading) [6]	Supraspinatus	3	4
		Infraspinatus	3	4
		Middle trapezius	3	4
		Lower trapezius	3	4
		Rhomboids	3	4
		Teres minor	3	4
		Deltoid	3	5
		Biceps	4	5
Muscle tightness	By tape measurement (from Mastoid process of ear to Acromio-Clavicular joint.	Upper trapezius	16 cm	20 cm
Special test		Foraminal compression test	Positive	Negative
		Distraction test		
		ULTT- Median nerve		
		ULTT- Radial nerve		

**[Table/Fig-5]:** Pre and post-treatment values [6].

Scale	Score- pretreatment	Score- post-treatment	Difference
Neck Disability Index (NDI) [5]	19/50 = 38% Disability (Moderate disability)	8/50 = 16% Disability (Mild disability)	22%

**[Table/Fig-6]:** Pre and post values of outcome measure.

lowering Abnormal Impulse Generating Sites (AIGS sensitivity) [8]. Thomas E et al., their research of all three studies pertaining to CNP, pain and disability indexes were analysed and showed that MET was the superior treatment compared to the other interventions for reduction in pain and disability [9]. Sahrman exercises address movement impairments by facilitating ideal muscle activation and joint alignment, which can correct aberrant movement patterns responsible for cervical dysfunction [10].

Alshami AM and Al Sadiq AI in their research, stated that scapulothoracic mobilisation, without the combination of Scapular stabilisation exercises, didn't enhance the function or decrease pain [11,12]. The regime of Scapular stabilisation exercises combined with scapulothoracic mobilisation offers greater mobility and stability through enhanced agility and strength. Since, there may be variations in the scapular dyskinesia-related muscle imbalance and mobilisation around the scapula in such patients, corresponding exercises need to be incorporated into the neck pain rehabilitation programme.

Authors have integrated PNF and virtual reality in enhancing muscle flexibility and correcting biomechanical alignment. PNF stretching applies specialised patterns to increase neuromuscular control and flexibility and thus enhance functional movement. Gashi AI et al., in

their study used PNF contract relax technique for treating cervical radiculopathy and found beneficial results [13].

Cervical muscles strengthened and aligned through virtual reality and exercise had good outcome by decreasing pain and correction of forward head posture. Asadzadeh A et al., in his work conducted on virtual reality worked on the concept of correcting forward head posture [14]. Sureshbabu Anbupriya M et al., in his work proved that participants had increased activation of neck flexor muscle and better Craniovertebral Angle (CVA) following the performance of the chin tuck exercises. Capital flexion-extension is another strengthening exercise that targets deep neck muscles and enhances posture [15].

## CONCLUSION(S)

The positive outcomes observed highlight the potential of comprehensive approach involving Mulligan mobilisation, scapular mobilisation, neural tissue mobilisation, PNF stretching, Sahramann exercise, virtual reality to reduce pain, improve mobility and muscle strength, correct posture, restore functions, and enhance overall well-being.

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