EFFECTS OF ACTIVE PHYSICAL THERAPY VERSUS PASSIVE TREATMENT IN PATIENTS WITH CERVICAL RADICULOPATHY

Ezzat El Sayed Moubarak[1], Mohamed K Seyam[2], Asmaa Foad Abdelmonem[3], Ahmed Abd El-Moneim Abd El-Hakim[4], Reem Dawood[5]

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Abstract

Background: Cervical radiculopathy (CR) is usually happened regularly and a common neuromusculoskeletal disorder causing pain in neck radiating to upper extremity, functional disability and associated with neurological signs and symptoms.
Objective: To detect the effects of active versus passive treatment in subjects diagnosed with CR.
Methods: A randomized comparative clinical study was applied on forty-two patients with acute unilateral CR and divided into two groups; active group (A, n=21) who received manual therapy, manual traction, and exercises of three supervised sessions weekly for 4 successive weeks in addition to daily home exercises. Passive group (B, n=21) who received collar, rest, patient education and correction.
Outcomes: For neck and arm pain using numerical pain rating scale (NPRS), for functional disorders using neck disability index (NDI). Each measure was evaluated at baseline and post-treatment, independent t-test has been used for differences between groups, and paired t-test for intragroup differences.
Results: Both groups showed statistically improvement in NPRS and NDI, and statistically differences between groups during rest and movement with favor to group (A), except arm pain during motion no significant difference.
Conclusion: Both treatment modalities were effective in treatment of CR, active physical therapy is superior to passive one after 4 weeks of treatment.

Keywords: Cervical radiculopathy, active treatment, passive treatment, pain

[1]Department of Rheumatology and Rehabilitation, College of Physical Therapy, Zagazig University Hospital, Egypt.
[2]Department of Physical Therapy and Health Rehabilitation, College of Applied Medical Sciences, Majmaah University, Saudi Arabia.
[3]Department of Biomechanics, Faculty of Physical Therapy, Cairo University, Galala University, Egypt.
[4]Department of Basic Sciences, Faculty of Physical Therapy, Beni-Suef University, Egypt.
[5]Physical Therapy Program, Batterjee Medical College (BMC), Jeddah, Saudi Arabia.

[*] Corresponding email: ezzatmoubarak91@gmail.com

1. INTRODUCTION

Cervical radiculopathy (CR) is an entrapment in the root of the nerve or inflammation, irritation, causing pain and functional disorders. Pain arising in the arm is referred as radicular pain and called as radiculopathy, also termed as pinched nerve which the nerve is compressed in the cervical area **(Cheng et al., 2015) (Qayyum et al., 2017).** Patients are generally presented with radiating pain, the main complain may involve, shivering, a dermatomal, myotomal and decreased or not found reflexes associated to the entrapped nerve root, and frequently lead to substantial functional disorders **(Caridi et al., 2011) (Woods & Hilibrand, 2015).**
The incidence rate of CR is 83 patients each 100,000 subjects, which elevated after fifty years of age (203 subjects per 100,000 subjects) and usually between 45 to 54 years old **(Fritz et al., 2014) (Zundert et al., 2010) (Leveque et al., 2015) (Mansfield et al., 2020).** Many causes lead to CR, as degenerative, inflammation of cervical structures as discs, articular facets joints or nerve roots, decrease in the intervertebral foramen due to irritation, and degenerative changes lead to neural inflammation, edema, hypoxia, ischemia, and fibrosis, and expanded mechanosensitivity **(Vernon & Mior, 1991).**
Subjects with both cervical and arm pain have more discomfort than subjects with cervical pain only **(Cheng et al., 2015) (Qayyum et al., 2017).** The degree of pain is usually signed by the subjects so that they can easily define the distribution and area of their pain and drawing by visual inspection **(Bernhoff et al., 2016).**
Frequently the CR is diagnosed through combination of history and physically examination, also confirmed by an MRI, CT and electrophysiological tests are

often used to detect the affected root **(Vernon & Mior, 1991) (Thoomes et al., 2018).**

The initial treatment is usually non operative, Immobilization, anti-inflammatory, analgesia, corticosteroid injections and physiotherapy as manual therapy and cervical traction are the mainstream of conservative treatment. About 75 to 90 percentage of subjects with CR are treated with conservative rehabilitation and is typically self- limiting but long-lasting **(Elnaggar et al., 2009) (Aydin & Yazicioğlu, 2012) (Savva et al., 2016) (Gregory & Mckivigan, 2018) (Woods & Hilibrand, 2015).** About 55% of patients improved within one year and 83% improved completely between two to three years **(Sleijser-Koehorst et al., 2018),** Patients with CR and not improved with conservative treatment may need corticosteroid injections or surgery **(Verhagen, 2021).** Surgery; as discectomy (anterior cervical) and fusion, artificial disc replacement, and laminoforaminotomy (posterior cervical). However, outcomes for motor radiculopathy postoperative are unclear **(Radhakrishnan et al., 1994) (Heckmann et al., 1999).** One study found that about 26% of patients who underwent surgery continued to experience pain at follow-up after 12 months **(Zundert et al., 2010) (Leveque et al., 2015).**

The physical therapy rehabilitation programs including manual and mechanically traction, postural advices and education, exercises, and manual therapy of the cervical spine and combinations of these. Manual therapy is effective in relief pain, joint limitations and functional disability, especially when combined with exercises; it may include mobilizations, manipulations, and nerve mobilization can be used as an evaluation and a therapeutic treatment modality of CR, which increases the flexibility and blood flow to indicate pain relief **(Neto et al., 2017).**

Cervical traction usually used for a subject with neck pain. Traction may be used alone, or with other modalities. It may be used for the treatment of disc problems, joint distraction, mobilization of the muscle and connective tissue, improvement of tissue–fluid exchange, and arterial, venous and lymphatic flow **(Kekosz et al., 1986) (Grieve, 1991).**

Cervical collar, rest, physiotherapy with home exercises is more beneficial in reducing acute radiating pain than wait and sees method. It is also evident that Manual cervical traction with mobilizations reduces pain and treat disability in subjects with CR more than mobilization alone **(Kuijper et al., 2009) (Boyles et al., 2011) (Fritz et al., 2014) (Shah et al., 2015).**

This study was designed to detect the effects of active compared with passive treatment approaches in the patients with CR, which no objective study has directly compared the effects of both treatment modalities. In this study we measured neck, arm pain, and neck disability index or functional disability thus during rest and movement pretreatment and post treatment and compared the results of both groups.

2. SUBJECTS AND METHODS

- **Study design**

A prospective randomized comparative, clinical study was designed to evaluate differences in neck, arm pain, and NDI of subjects with CR receiving active and passive treatment modalities thus during rest and motion. All subjects were fully informed about the purpose and methods used in the study, and gave written informed consent prior to participation.

- **Ethical considerations**

The current study was approved according to the ethical committee guidelines for biomedical research on human participation, from Zagazig university institutional review board carrying reference number (**ZU-IRB#10763-3-3-2023**). Before commencing the study, informed consent was obtained from all subjects, notifying them that they can discontinue at any time.

- **Enrollment**

Subjects were diagnosed by orthopedic surgeons or neurologist and conformed by applying MRI and or CT scans as having CR who were referred to the outpatient physiotherapy clinic, and initially recruited. Before enrollment, patient's eligibility to share was evaluated.

- **Subjects:**

Forty-two males and females subjects with CR were introduced in the study and randomly divided into active (n=21) and passive (n=21) treatment groups. Subject who were enrolled in this study fulfilled the following criteria: a) age ranged from 25 to 45 years old, b) radiating symptoms, subjects with symptoms for at least 2 months, c) unilateral deficits and if at list 3 of four tests were a positive or found as; upper limb neurodynamic test 1, spurling's test, distraction test, and ipsilateral cervical rotation of less than 60 degree **(Sarfaraj & Deepali, 2018).** Subjects excluded if they have; both upper limbs symptoms, signs of superior motoneuron impairments, trauma, rheumatoid Arthritis, Osteoporosis, malignancy, hyper mobility, radial and ulnar nerve involvement, frozen shoulder and vertebra-basilar insufficiency syndrome **(Savva et al., 2016) (Langevin et al., 2015) (Sarfaraj & Deepali, 2018) (Gebreyohanes et al., 2022) (Mallard et al., 2022),** enrollment of the subjects were shown in **Figure (1).**

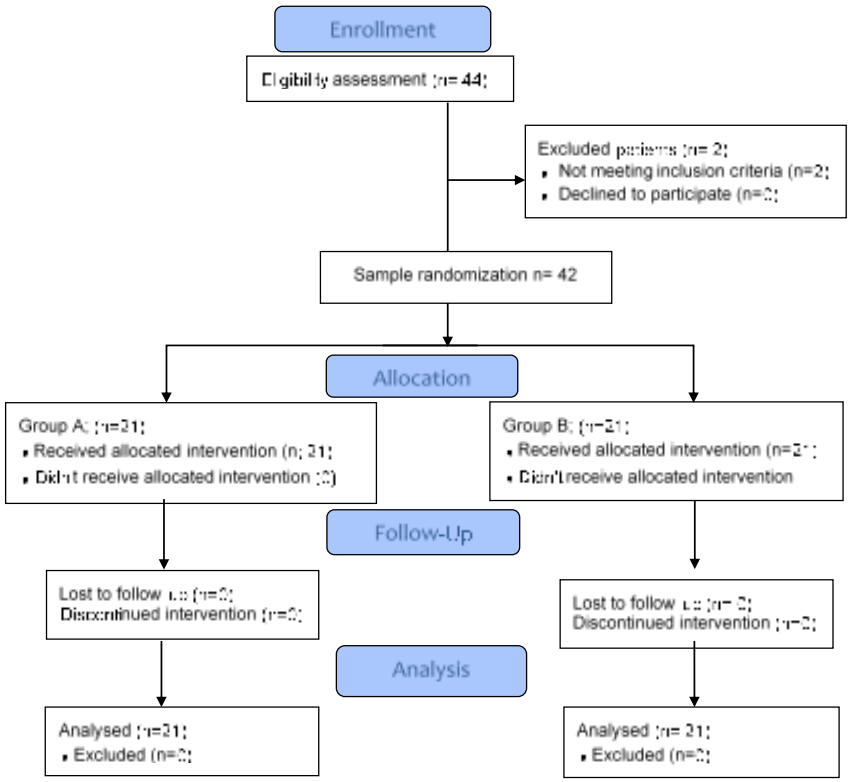

Figure (1): Participant flow diagram during study

INTERVENTIONS

The procedure for Active treatment group (A):

The patients were received 12 sessions three sessions day by day each week for four weeks 30 min each session, inform of manual traction, mobilizations, and exercises. The patients received and trained a home exercise program on each session **(Dmytriv et al., 2010).** The Manual traction was performed in supine lying at 25 degree neck flexion with ten second pull and five second rest for ten times in each session. Manual traction causes widening of the intervertebral foramen. The force for manual traction was applied to cause a fifty percentage reduction in neck pain. Followed C-3 to C-7 segments was mobilized by central posterior anterior glide in prone position at and each glide was sustained by five seconds for ten repetitions every session. The therapist instructed the patient to perform specific exercises. Exercises included cervical retraction, strengthening exercises for the neck flexors, axial extension exercises, scapular strengthening, and stretching exercises **(Young et al., 2009) (Bukhari et al., 2016).** Besides applying exercises each session, they were also taught to perform daily exercises at home (10 repetitions 5 seconds, once/day), A video record of home performance was observed by the physiotherapist regularly. All active treatment modality were supervised by the same physiotherapist to ensure the accuracy of performed movements **(Langevin et al., 2015).**

The procedure for Passive treatment group (B):

Patients in this group wear a semi-hard, snugly fitted collar daily for four weeks, and removed after four weeks **(Dmytriv et al., 2010).** Also patients were instructed to rest as much as possible, posture education and correction of the spine during sitting and standing activities, forward head posture, and protracted shoulders also educated upon adopting ergonomic principles during desk work (e.g. using a desk and chair of appropriate height) **(Kuijper et al., 2009) (Young et al., 2009) (Bukhari et al., 2016).**

Outcome measures

Outcome measures were performed before and after four weeks of treatment. The outcomes were measured by NPRS for neck and arm pain and NDI for functional disability. NPRS is usually used in combination with NDI **(Cleland et al., 2008) (Childs et al., 2005) (Hawker et al., 2011) (MacDermid et al., 2009) (Young et al., 2009) (Bukhari et al., 2016) (Thoomes et al., 2013)(Rodine & Vernon, 2012) (Bono et al., 2011) (Savva & Giakas, 2013).**

A-Pain intensity (NPRS).

NPRS is a Self-reported scale was used to evaluate the intensity of neck and arm pain during rest and motion, using a 11-point pain scale. Patients were instructed to point on a line from 0 to 10cm which

best describes his or her pain degree (0 mean no pain and 10 mean worst imaginable pain). The point was measured using a measuring scale (in cm). The same question will be asked for the arm pain **(Bono et al., 2011) (Savva & Giakas, 2013) (Rodine & Vernon, 2012) (Thoomes et al., 2013) (Sarfaraj & Deepali, 2018).**

B- Neck Disability Index (NDI);

NDI is a ten item questionnaire (scored from zero to five, total score fifty which zero= no disability, fifty = severe disability), measured a subject's self-reported neck pain related disability. It was firstly published in 1991 and reviewed in 2008 by the same author **(Vernon & Mior, 1991) (Vernon, 2008).** Questions include activity of daily living as: subject care, sleeping, lifting, working, reading, driving, recreational activities, degree of pain, headache and concentration **(MacDermid et al., 2009).** Some studies multiply it by two and an overall score out of 100 is calculated by adding each item score together **(Elnaggar et al., 2009) (MacDermid et al., 2009).** For subjects with CR, the minimal detectable differences is ten degrees, and the main important clinically difference is seven degrees **(Cleland et al., 2008) (Wlodyka-Demaille et al., 2002).**

Sample size

Depend on the previous study **(Meyer & Krueger, 2001; Cleland et al., 2008; Savva et al., 2016),** and considering the primary outcome of NDI. The minimum differences of standard deviation (SD) for the NDI have been found to be 7/ 50 for patients presenting with CR. Our sample size estimated for final data analysis was forty two patients. Twenty one for each group using the OPEN-EPI program. The sample size of both groups will provide sufficient power of 0.80, and 95% Confidence Intervals (CIs) to detect a clinically important difference between the both groups.

Randomization

The randomization was performed by (a computer-generated randomization) as every patient was given a unique identifying number that needed which group they would be evaluated. Individually numbered index cards were regularly inserted in non-transparent envelopes and every patient a hand-picked envelope and assigned to their respective groups.

DATA ANALYSIS

The Statistical Package of Social Science (*SPSS, Chicago, IL, USA, version 22*) was used to generate results. The normality of the data was tested using the Shapiro-Wilk test. Numerical data were summarized as means and standard deviations (SD). A T- test was performed to identify the differences between the both groups. Comparison between two groups for numerical variables was done using unpaired t-test, while comparison for each group before and after treatment was done using paired t-test for each group, on neck, arm pain during rest and during motion also neck disability index in patients with CR. When the $P \leq 0.05$, it was considered significant.

3. RESULTS

Participant characteristics

Forty four participants were eligible for this study, and forty two randomized into two groups (figure1). The mean age of the participants were (34.33±6.12) for group A, and (35.8 ± 5.96) for group B, no significant differences between both groups as age (p-value= 0.43) (table 1).

Table (1): Demographic Data:

Variables	Group(A) n=21 Mean ± SD	Group(B) =21 Mean ± SD	P-Value
Age (years)	34.33±6.12	35.8 ± 5.96	0.43
Sex (male/female)	11/10	12/9	
Affected side (Rt /Lt)	14/7	13/8	

Within group (Intragroup) comparison

Within group (Intragroup) comparison after four weeks of treatment the mean values within each group revealed a significant decrease and differences in neck and arm pain intensity thus during rest and motion also significant decrease in neck disability or functional disability before and after treatment in both groups ($p < 0.05$) (Tables 2).

Between groups (intergroup) comparison

At pre-treatment, results revealed a non-significant difference between the two groups as regard to neck and arm pain, neck disability index ($p > 0.05$). Post- treatment and between groups differences revealed significant differences in all variables with superior to group (A) where ($P < 0.05$), except arm pain during motion no significant difference between both groups after treatment (p-value 0.44) **(Table 2).**

Table (2): Intragroup and intergroup comparisons for group (A) & group B at pre- and post- treatment.

Variables		Group A (n=21) Mean ± SD	Group B (n=21) Mean ± SD	p-value
1. Neck pain (NPRS) a. During rest	**Pre**	6.7± 0.89	6.96 ±0.83	0.332
	Post	3.1±0.376	4.61±0.579	0.000
	***p*-value**	0.000	0.000	
b. During motion	**Pre**	7.1±0.501	7.4±0.654	0.109
	Post	3.45±0.44	5±.67	0.000
	***p*-value**	0.000	0.000	
2. Arm pain (NPRS) a. During rest	**Pre**	6.95 ±1.20	7.12 ±0.655	0.55
	Post	3.5±0.758	4.48±0.534	0.000
	***p*-value**	0.000	0.000	
b. During motion	**Pre**	7.21±0.55	7.23±0.668	0.91
	Post	4.25±0.422	4.601±.703	0.44
	***p*-value**	0.000	0.000	
3. Neck disability index (NDI)	**Pre**	18.39±1.88	18.94 1.38	0.284
	Post	11.07±1.20	14.15±1.06	0.000
	***p*-value (Intragroup statistics)**	0.000	0.000	

4. DISCUSSION

This clinical study evaluated the impact of active treatment which including manual traction, manual therapy and exercises beside home exercises, and the impact of passive treatment which including rest, collar, and patient education and correction, and to compare the both treatment modality in subjects with CR. Although the results revealed no inter-group differences at baseline, the results indicate that both active and passive treatment approaches, experienced significant improvements on the NPRS and lower degrees on the NDI during rest and motion were found after four weeks of intervention, and importantly, there were significant differences inter-group with favor to active treatment group (A) after completing four weeks thus indicating that subjects receiving the active treatment modality exhibited a good degree of function and a decrease the degree of pain and disability.

According to the study's findings, both active and passive treatment groups experienced significant neck and upper extremity pain decrease after four weeks of training. The results are supported by a study of **Aydin and Yazicioğlu. (Aydin & Yazicioğlu, 2012)** who compared the difference between routine physical therapy modalities as hot application, therapeutic ultrasound, TENS, and therapeutic exercise, combined with or without cervical traction and found significant lower scores in VAS ratings compared with the baseline scores in the two groups after fifteen sessions of physiotherapy in patients with CR. Also, **Elnaggar et al. (Elnaggar et al., 2009),** studied the efficacy of both cervical traction (intermittent and continuous) on neck and arm pain severity in patients with CR, they found that traction significantly decrease the cervical and upper limb pain, with favor to intermittent traction.

Bukhari et al. (Bukhari et al., 2016) has explained pathophysiology of subjects with CR through tourniquet effect which said that when tissue pressure ranged between 30 to 50 mmHg, lead to decrease blood flow in veins, and stagnation of venous fluid causing pressure on the neural structure, edema to form around the axon since fluid can't enter the nerve and arterial blood can still enter the swelling develops further so the treatment modality directed to remove the pressure on the neural structure.

Study by **Fritz et al. (Fritz et al., 2014)** studied three groups; therapeutic exercise, exercise combined with mechanical traction or exercise combined with over door traction, the results of outcome measures after one month, six months, twelve months, they found that exercise with mechanical traction decrease pain and disability, especially with long period of treatment. In addition, these finding are consistent with **Jellad et al. (Jellad et al., 2009)** who studied the effect of conventional rehabilitation with manual and intermittent traction after one, three, and six months the outcome measures were cervical, and arm pain, and found improvement especially after long-time follow-up. Savva and **Giakas (Savva & Giakas, 2013)** study the effect of both traction and neural mobilization in subjects with CR and found that traction with neural mobilization can significantly decrease pain and functional disability.

On contrary to our study **Young et al., (Young et al., 2009)** perform exercise, manual therapy, and traction for subjects with CR and examined their effects on pain severity, function, and disability and found no inter-group differences for both the primary and secondary outcomes at two or four weeks. Also, **Young et al. (Young et al., 2009)** said that adding of

mechanical traction to a multimodal treatment program of manual therapy and exercise yields no significant benefit to pain, function, or disability in subjects with CR, and found lower pain and disability after long-term follow ups.

Our study was agreed with the study by **Kuijper et al. (Kuijper et al., 2009)** who studied and compared the effects of physiotherapy, collars, and a wait-and-see in addition to daily home exercises in improving symptoms of CR, they found the measured variables were changed with time in cervical and arm pain, using a 100-mm VAS and a 100-point NDI which were performed after three, six weeks and after six months, differences virtually not found, and reported that both active and passive treatment better than wait and-see strategy in reduction of neck and arm pain.

Sarfaraj and Deepali (Sarfaraj & Deepali, 2018) study the effects of strengthening exercises, neural mobilization beside intermittent traction in patient with CR and found significantly improvements but inter-group findings may not give a pure result about which treatment modality is better than another.

Some investigators supports physiotherapy, and advocate the use of a collar or a cervical pillow during lying or sleep for short term period as **Levine et al. (Levine et al., 1996)** compared the effects of five modalities of treatment (cervical traction, patient positioning, neck collar, placebo tablets, and sources of heat), they found no significant difference in pain and ability to work. This study trial was done nearly fifteen years, on 493 patients, however, the investigators did not perform validated outcome scales **(Levine et al., 1996) (Wainner et al., 2003).**

Tahir et al., (Tahir et al., 2022) study the effect of both traction and strengthening exercises in subjects with CR and reported that strengthening exercises less effective than manual traction in improving the disability and radiating pain. **Kuijper et al. (Kuijper et al., 2009)** reported, although the physiotherapy and collar groups had low pain at three, six weeks compared with the controls and all three groups showed same degree of improvement at the end of study and the authors found low difference in use of analgesics. The authors hypothesize that wearing cervical collar decrease inflammation and compression in the foramen root; this could explain the higher decrease in arm, neck pain and neck disability found in their study. And explained /the decrease in pain especially with physiotherapy is probably related to neck muscles strength regained **(Levine et al., 1996) (Wainner et al., 2003).**

LIMITATIONS:

- This study was limited to long term follow up period.
- The subjects in our study depend on specific etiology and duration of symptoms which were not screened. Future studies recommend comparing a mechanical versus an inflammatory stimulus in subjects with CR.
- Without a control group we are unsure whether there was as continuous improvement of symptoms after four weeks of treatment.
- Patients' compliance with the home program could not be fully guaranteed, although the participant's video records were checked each session.

5. CONCLUSION

In the short-term treatment among patients with unilateral CR, both treatment modality were effective in treatment of CR, active treatment approach was superior to passive treatment approach in reduction of neck, arm pain and neck disability index. Clinical relevance improvements obtained in this study highlighted the importance of active treatment modality in treatment of subjects with CR.

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