

## Efficacy of Deep Cervical Flexors Training in Patients with Chronic Neck Pain-A Review Article



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### Abstract

**Introduction:** Neck is affecting approximately 70% of people. In one year, 30% of adults are reporting Neck Pain. Impairment of deep cervical flexors (DCF)s leads to insufficiency in coordination, activation and poor support on cervical structures that further lead to development of neck pain and altered neck posture.

**Purpose of the study:** The purpose of this study is to review the available recent studies on the effects of DCFs training on forward head posture, muscular endurance and cervical mobility with a pressure biofeedback unit.

**Methodology:** We performed a research on common digital databases like Google scholar, PubMed, Pedro and Sci-Hub. Search results were limited to articles written in English and published between January 2015 to October 2022. The search provided a total of 781 articles. All articles were analyzed on the basis of title and abstract. There were 15 articles met with eligibility criteria and available with full text article. Study design of all included article were RCT or intervention studies, systemic review and cross sectional studies.

**Results:** Evidences suggest that DCFs training reduces forward head posture, increases muscular endurance and improves cervical mobility with a pressure biofeedback unit as like other physiotherapy treatments but it is more beneficial with traditional physiotherapy treatments better than only conventional physiotherapy treatments.

**Conclusion:** DCFs training is effective in reducing forward head posture, increasing muscular endurance and improving cervical mobility in patients with chronic neck pain.

**Keywords:** Deep cervical flexors training, Pressure biofeedback unit, Neck pain, Cervical functions, Forward head posture.

### Introduction

Increasing impairment in the general population is a medical condition that affects the cervical region of the body. One of the most common musculoskeletal problems is neck pain (NP). Approximately 70% of people are predicted to encounter NP at least once in their lives. Clinical findings associated with NP include diminished neck muscle strength, limited deep cervical muscle endurance, poor cervical proprioception, forward head position, restricted cervical movement, psychiatric conditions such as anxiety and depression, and impaired balance.

Neck pain is linked to cervical spine muscular weakness, namely in the deep and anterior neck flexors. Because of the compressive loading of the cervical tissues, people with neck pain are more inclined to adopt a forward head position (FHP). The deep neck flexors (DNFs), especially the longus capitis and longus colli, have been proven

to be one of the neuromuscular constraints for neck discomfort. Muscle weakness may result in inadequate coordination, loading, activation, and support for the cervical structures, which can further contribute to altered posture.

Studies have been done on how prescribed and functional tasks affect the behavior (activity) of the deep and superficial neck muscles. Since they have some functional specialisation in sustaining the weight of the head, the majority of research to date has been on the neck flexors, the deep longus capitis and colli muscles, as well as the superficial sternocleidomastoid (SCM) and anterior scalenes (AS) muscles. Patients with neck discomfort have altered muscle behavior as decreased (reduced) deep flexor activity along with increased SCM and AS activity.<sup>11</sup>

Retraining the DNF muscles enhances their degree of activation, which increases their capacity to maintain cervical vertical alignment while

reducing the symptoms of neck discomfort. Exercises for the DNF specifically target its musculature

In order to build muscular strength, endurance, and flexibility to recover damaged tissues and support regular living activities, exercise is one of the most often employed modalities in the rehabilitation of people with neck pain. The length, repetition frequency, intensity, and kind of exercise used in various exercise regimens for treating neck discomfort vary.<sup>5</sup>

DCF training is done in supine laying or various postures, such as sitting, with minimal loads and little resistance. The exercise programme is based on studies showing that people with neck pain have less deep flexor activation during craniocervical flexion than people without a neck pain issue, and they have more (compensatory) activation of the SCM and AS. An inflatable pressure sensor that was put behind the neck and measures pressure at baseline (20 mmHg) provides guidance. The person attempts to target five progressive positions of increasing range i.e.

## Methodology

The search engines used for finding the appropriate articles were Google scholar, PubMed, PEDro and Sci-Hub.

Study were selected using keywords: “deep cervical flexors training” or “deep neck flexors exercise” or “craniocervical flexion test (CCFT)”, “ Pressure biofeedback unit”, “chronic Neck pain”, “ Cervical pain”, “Forward head posture”.

Search results were limited to articles written in English and published between January 2013 to October 2022.

The search provided a total of 781 articles. All articles were analyzed on the basis of title and abstract. There were 15 articles met with eligibility criteria and available with full text article. Study design of all included article were RCT or intervention studies, systemic review and cross sectional studies.

If they had experienced pain in the scapula, upper extremities, lumba spine or hip joints which developed regional instability. Total articles identified on search engine like - Google Scholar, PubMed, PEDro and sci-hub. Search results were limited to articles written in English and published

flexing to reach pressure increments of 22 mmHg, then to 24 mmHg and so forth to 30 mmHg.<sup>11</sup>

The therapy of patients with NP has been demonstrated to result in reduced or delayed activation of the deep neck flexors (DNFs), notably longus capitis and longus colli. One of the commonest and most cutting-edge clinical approaches for reaching this objective is the improvement of DNF with Pressure Biofeedback (PB). Researchers are looking into the suitability of pressure stabilizers for retraining motor control in NP patients because to how easily they can provide pressure biofeedback. In order to ascertain the impact of motor control training of DNF with PB on pain and impairment in patients with NP, the primary goal of this study was to conduct a systematic review and meta-analysis.

The purpose of the study: This study is to systematically review the literature using the exercise intervention of DCF training in patients with chronic neck pain to determine any evidence of its effectiveness in addressing impaired physiological changes.

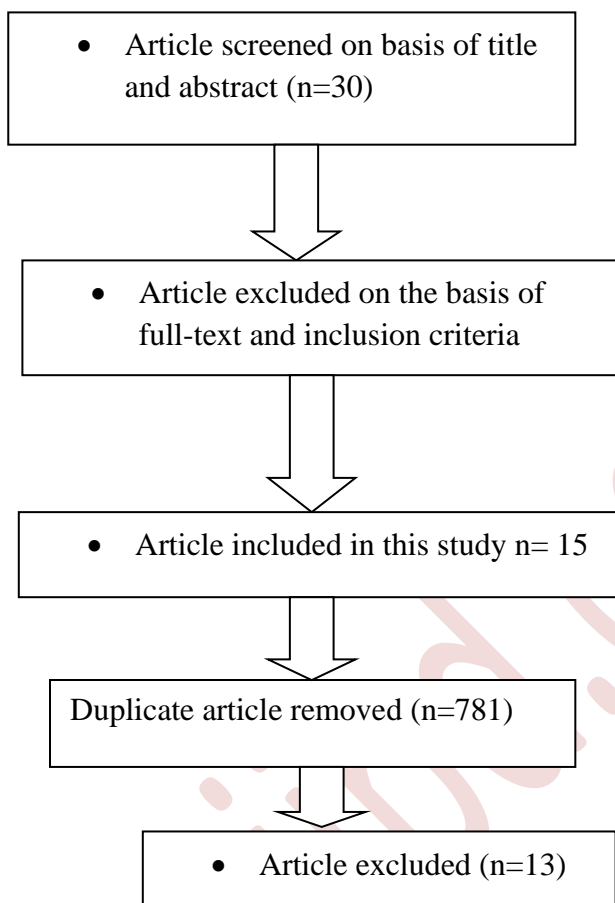
**Selection criteria:** we included studies that met the following inclusion criteria:

- Article published in English
- Study population aged between 18 to 65 years
- NPRS more than 3
- NDI Score
- Randomized controlled trial on efficacy of deep cervical flexors training in chronic neck pain

## Exclusion criteria

- Neoplasm
- neurological diseases
- vascular diseases,
- history of cervical spine surgery or neck injury or surgery,
- neurologically deficient radiculopathy,
- inflammatory arthritis,

between January 2015 to October 2022 using key words “deep cervical flexors training” or “deep neck flexors exercise” or “craniocervical flexion test (CCFT)”, “ Pressure biofeedback unit”, “chronic Neck pain”, “ Cervical pain”, “Forward head posture”.



Study	Participants characteristic (age, number of patients, inclusion criteria)	Intervention Group A	Intervention Group B/ Group C	Protocol	Primary outcome	Conclusion
<b>A. ABDEL-AZIEM Et al (2022)</b>	Number of patients : 55 Ages: 30 to 50 years Inclusion criteria: chronic neck pain without any arm pain or discomfort.	Deep neck flexors exercises, scapulo thoracic exercise	A-Traditional physiotherapy B-McKenzie protocol	<b>A-</b> five days a week( 10 sec hold for 10 times) <b>B-</b> twice a day <b>C-</b> three sets per day	Cervical ROM, VAS, NDI	DNF and scapulothoracic exercises, combined with traditional physical therapy, were more effective than the traditional physical therapy alone.
<b>Ahmad H. Alghadir Et al (2021)</b>	Number of patients: 55 Age : 25 to 40 years Inclusion criteria: NDI More than 5	Cranio cervical flexion test	stretching and strengthening exercises	<b>A-</b> thrice a week for four week .Two minutes rest was given between the	NPRS FHP CV	Improvement was more significant among those who received additional DCF muscle training using pressure biofeedback.

				sets B-3 sets of 10 repetitions with 10 seconds hold and rest of 2 minutes in between for 4 weeks		
<b>Jacobo Rodríguez-Sanz et al (2020)</b>	Number of patients : 58 Ages: 30 to 50 years Inclusion criteria: chronic neck pain without any arm pain or discomfort	DCF training and manual therapy	B –manual therapy + exercise (manipulation-high velocity, low amplitude and/or mobilization )	A- 10 repetitions for 10 s, with a 40 s rest between each repetition  B-One day a week for four weeks	NDI, VAS CERVICAL ROM	DCF Training combined with manual therapy is more effective.
<b>Rose Boucaut et al (2019)</b>	Number of patients:54 Age: 18 to 60 years Inclusion: NDI ≥10	semispinal is cervix training (6 weeks)	B-deep cervical flexor training (6 weeks) C-general exercise, including stretching and upper-limb-strengthening exercises, modalities, manual therapy, or electrotherapy	A- twice per week over a 6-week  B- twice per day for thrice in a week  C-20–30 minutes for 6 week	NDI, NPRS , CV angle	Semispinalis cervicis-training and deep cervical flexor training outcomes showed benefits over usual-care outcomes
<b>SinHo Chung et al (2018)</b>	Number of patients:52 (26 in each group)  Inclusion criteria: tenderness or pain above the cervical joints.	Cranio cervical flexion test	Neck isometrics exercises	A-10 repetitions per session for 4 times in a week for 3weeks B-3 times a week, for 8 weeks	VAS, NDI, Muscle endurance, Cervical ROM	CFE was useful for improving or restoring the cervical lordosis, the endurance of deep cervical flexor muscles, and the ACROM of all three planes compared with a NIE muscle retraining program.
<b>Hoda M Zakaria et al (2017)</b>	Number of patients:30  Inclusion criteria: (1)diagnosed by the neurologist as cervical disc lesion either a single level or multilevel. (2) suffered from	US+TENS And post-isometric relaxation for upper trapezius, levator scapulae, sternomastoid and scalene muscles and DCF	US( 1.5-2 W/cm2 intensity frequency of 1 MHz over the paraspinal muscles of the neck for 8 minutes )+TENS( arm using two surface electrodes with	six consecutive weeks period for three sessions per week (day after day).- for both the groups.	Neck Pain and Disability Scale (NPAD)  Cervical range of motion (CROM) device	craniocervical flexion exercise combined with postisometric relaxation technique and conventional physical agents are effective in reducing neck pain, improving kinesthetic sensation and thereby increase postural stability

	chronic, nontraumatic cervical pain for more than six months and the degree of pain should be mild to moderate according to (VAS), (3) their age 30-50 years	training	a pulse duration of 100-120 $\mu$ s, a frequency of 90-130 Hz, and a duration of 15-20 minutes ) And isometric relaxation .			
<b>Tomás Gallego Izquierdo et al (2016)</b>	Number of patients:28  Inclusion criteria: age between 18 and 55 years, score $\leq$ 15/50 on the Neck Disability Index (NDI)	Cranio-cervical flexion training	Proprioceptive training	<b>A</b> -1 set of 10 repetitions of 10 s for thrice a week  <b>B</b> -3 sessions in every 2 weeks -45 min for each session	Performance on the craniocervical flexion test VAS NDI	Proprioception training may provide an additional benefit of facilitating the deep cervical flexor muscles.
<b>Amr Almaz Abdel-aziem et al (2016)</b>	Number of patients: 60  Inclusion criteria: chronic neck pain	Deep neck flexor training	B-Isometrics exercise and stretching  C- Scapulothoracic exercises	<b>A</b> - 10 seconds hold for 10 times for 4 weeks <b>B</b> -30 min of each session for weeks <b>C</b> -four weeks (five days each week).	VAS NDI	combination treatment of DCF exercise + PTA is the most effective intervention for the management of neck pain, with some advantages in pain, disability, and ROM over the combination of isometric, stretching, and scapulothoracic exercises + PTA, or PTA alone.
<b>PavlosBobos et al (2016)</b>	Number of patients:92  Age: 18 to 65 years Inclusion criteria :chronic neck pain, NDI 5/50	Deep neck flexors training	"cat-camel motion exercise Home exercise	30-40 minutes per session for 7 consecutive weeks for each groups.	NDI NPRS SF-12 Cranio cervical angle	All therapeutic groups showed adequate reduction in disability and pain but there was no effect on pain pressure thresholds over the sensitivity.
<b>Kwan-woo Lee Et al (2015)</b>	Number of patients :46 Age: 18 to 60 years Inclusion criteria:	Thoracic Manipulation combined with DCF training and self stretching	Group B-DCF training and self stretching  Group C- active ROM (neck flexion, extension, lateral flexion, and rotation)	3days a week for 10 week for each group	VAS NDI Cervical ROM	DCF training was effective at improving neck function, compared with self-exercise in patients with chronic, non specific neck pain. Moreover, thoracic manipulation combined with DCF training resulted in greater pain reduction, improvement in muscle strength and endurance, ROM ,and NDI.

<b>Jin Young Kim et al (2015)</b>	Age: 46.7± 4.2  Number of patients:30  Inclusion criteria: NDI score <15	Deep cervical flexors training	General Strengthening exercise	<b>A</b> -3 times per week for 4 weeks  <b>B</b> -3-5 times for 10 seconds for 4 weeks	NDI NPRS	The DCF activation exercise significantly lowered the NRS scores, specifically from the baseline to 4 and 8 weeks after exercise. In the GES group, the NPRS did not significantly decrease before, 4 weeks after, and 8 weeks after exercise.
<b>Dong Yeon Kang et al (2015)</b>	Age: 23.9 ±3.3 Number of patients:20  Inclusion criteria: College going student who have a chronic neck pain	Deep cervical flexor training with PBU	-	Three times a week for six weeks	NDI Cervical ROM	The experimental group showed significant improvements in cervical ROM, and muscular endurance but not in craniocervical angle at post-training and after the four-week detraining period, compared to pre-training.

VAS- Visual analog scale, NPRS- Numeric Pain Rating Scale, DCF- Deep Cervical Flexors

**Result**

In this study 15 articles are included based on a therapy and eligibility criteria. In these articles researchers provide Deep cervical flexors training (DCF) for one group and other therapies for another group. All articles average sample size is 50 and average age group is 18 to 65 years old with more than 3 months period of neck pain. The outcomes are VAS OR NPRS for neck pain and for functional performance outcomes is NDI and cervical ROM.

In these studies DCF or a combination of DCF is compared with other conventional therapy. In the all included studies, DCF shows statically significance changes more than or equally effective with the other therapy techniques group. Combination of DCF and other conventional therapy shows clinically significant changes more than other conventional therapy alone.

**Discussion**

Neck pain is a recurrent disorder and comes with enormous personal, social and financial costs.

Training, NDI- Neck Disability Index, CCFT- Cranio Cervical Flexion Test

Exercise is a cornerstone of rehabilitation and a desired outcome is to reverse the impaired physiological functions towards prevention of recurrent episodes. This study found that DCF training was more effective in addressing altered muscle behavior by reducing activity in the superficial muscles SCM and AS and increasing activity in the deep craniocervical flexors, as well as improving performance in the CCFT. Little if any change in muscle behavior was achieved with the comparators of strength, endurance, flexibility or no training. This specificity of DCF training was also reflected in the study measuring muscle size where this training selectively increased the size dimension of longus capitis/colli, an outcome not achieved with strength training.

This systematic review was the first about the effectiveness of DNF training with PB on pain and disability of patients with NP, and therefore its results cannot be directly compared with the results of another study. Two previously performed systematic reviews were not targeted to



this research question. In contrast to the one systematic review, our study included only studies which used PB motor control training of DNF and studies that were focused on pain and disability rather than on neuromuscular function, muscle size, kinetics and kinematics. Furthermore, the second systematic review is a review of a

## Conclusion

DCF's training is effective in reducing forward head posture, increasing muscular endurance and improving cervical mobility in patients with chronic neck pain.

## Limitation of the Study

The limitation of this study was the small number of article, small sample size.

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