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Restricted Cervical Range of Motion and its Association with Pain Intensity in Patients with Chronic Neck Pain: An Observational Study

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Abstract

Background: To quantify active cervical range of motion (ROM) in patients with chronic neck pain and to examine its association with pain intensity.

Materials and Methods: In this cross-sectional study, 29 patients with chronic neck pain (22 men, 7 women; aged 20–70 years) attending private physiotherapy clinics in Zawia, Libya were assessed. Active cervical ROM in flexion, extension, lateral flexion, and rotation was measured with a universal goniometer using standardized patient positioning and landmark alignment, and pain intensity was recorded on a 10-point visual analogue scale (VAS). One-sample t-tests compared observed ROM against published reference values, and Pearson correlations examined the relationship between each movement and pain intensity ($p < 0.05$).

Results: All cervical movements were significantly restricted relative to reference values (all $p < 0.001$). Mean values were 33.6 ± 7.7° for flexion (reference 50°), 30.6 ± 6.2° for extension (reference 80°), 36.6 ± 11.5° and 36.8 ± 11.6° for right and left rotation (reference 85°), and 33.9 ± 13.2° and 32.8 ± 8.9° for right and left lateral flexion (reference 45°). Correlations between ROM and pain intensity were weak and, with one exception, non-significant; right lateral flexion showed a borderline inverse association ($r = −0.345$, $p = 0.067$).

Conclusions: Cervical ROM is markedly and globally restricted in chronic neck pain. However, individual pain intensity is only weakly related to the degree of motion restriction, suggesting that restricted ROM reflects a global functional impairment rather than tracking pain severity on an individual level. ROM assessment should therefore be complemented by other clinical measures when evaluating these patients.

Keywords: Neck pain; Range of motion; Goniometry; Pain intensity; Cervical spine.

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INTRODUCTION

Neck pain ranks among the most prevalent musculoskeletal disorders and remains a major source of disability worldwide, with an estimated 222 million prevalent cases and rising incidence linked to sedentary work and increased computer use. [1,2] Once established, chronic neck pain frequently restricts participation in work and daily activities and responds unpredictably to treatment. [3] Identifying the physical impairments that accompany chronic neck pain is therefore essential for rational, guideline-based management.

Among the physical impairments observed in this population, reduced active cervical range of motion (ROM) is one of the most consistent findings and is routinely used by clinicians as an outcome measure and as an indicator of treatment response. [4,5] Motion restriction may arise from pain-related guarding, altered muscle activation, or degenerative change, and its relationship with pain intensity has been

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debated: while some studies report moderate associations between ROM and disability, others find that physical measures correlate only weakly with self-reported pain. [6]

Beyond biomechanical structural limitations, recent neurophysiological frameworks highlight the contribution of central sensitization and fear-avoidance behaviors to movement restriction in chronic neck conditions.[7] Persistent nociceptive input can induce alterations in central pain processing, leading to mechanical hyperalgesia and protective muscle guarding even in the absence of ongoing tissue damage. [8] This secondary motor inhibition often manifests as restricted movement arcs during clinical evaluation, illustrating how central nervous system amplification can artificially limit active joint range. [7,8]

Furthermore, psychological factors such as fear of movement (kinesiophobia) and pain catastrophizing can actively constrain active range of motion by prompting premature cessation of movement prior to true anatomical boundaries. [6,8] When individuals anticipate movement-induced pain, voluntary motor output is constrained by protective motor strategies, confounding pure biomechanical assessments. [7] Recognizing the complex interplay between spinal mobility, pain perception, and cognitive-behavioral responses is crucial when evaluating mechanical neck disorders in clinical settings.

Most of the available evidence originates from outside Africa. To our knowledge, no study has characterized cervical ROM in Libyan patients with chronic neck pain. The present study therefore aimed to quantify active cervical ROM in this population, to compare it with published reference values, and to examine the correlation between ROM and pain intensity.

Measurement reliability is the foundation of ROM research. Araujo et al. [4] demonstrated excellent test–retest (ICC ≥ 0.986) and inter-rater (ICC ≥ 0.947) reliability for goniometric assessment of cervical ROM in individuals with chronic neck pain, confirming that the universal goniometer remains a valid clinical instrument. Comparative work has further shown that different bedside instruments yield concordant measurement, supporting the interchangeability of commonly used methods in routine practice.

Exercise-based rehabilitation is the principal guideline-endorsed intervention for chronic neck pain, and improvements in ROM frequently accompany reductions in pain and disability. Price et al. [9] showed in a systematic review that exercise training reduces pain and disability in chronic non-specific neck pain, although the optimal dosage remains uncertain. de Zoete et al.[10] reported that general physical exercise produces beneficial effects compared with usual care, and Yang et al.[11] found that isometric training significantly reduces pain intensity and improves neck function. Gumuscu et al.[12] directly compared stabilization, isometric, and conventional exercise programs in a randomized trial, observing improvements across approaches, while Grooten et al. [13], in an umbrella review of systematic reviews, concluded that all major exercise types have positive short-term effects on pain. Collectively, this literature positions restored motion and reduced pain as complementary rehabilitation goals.

Accurate pain measurement is equally important. The visual analogue scale and its digital derivatives demonstrate strong psychometric properties in musculoskeletal pain, with high reliability and responsiveness. [14] Combining valid ROM measurement with validated pain scales allows the pain–motion relationship to be examined directly, which was the objective of the present study.

MATERIALS AND METHODS

Study Design and Setting

This was a multi-center, cross-sectional, observational study conducted between December 2020 and January 2021 in the physiotherapy departments of two private clinics (Aldeqaa Clinic and Almokhtar Clinic) in Zawia City, Libya.

Participants

Twenty-nine patients of both sexes (22 men, 7 women), aged 20–70 years, with chronic neck pain were recruited by convenience sampling from among patients receiving physiotherapy. Exclusion criteria included acute cervical trauma and neurological disease affecting the

neck. The study purpose and procedures were explained to all participants, written informed consent was obtained, and anonymity was guaranteed. Participation was voluntary.

Measurements

Active cervical ROM was measured bilaterally for all six movements (flexion, extension, right and left lateral flexion, right and left rotation) with a universal goniometer, with the patient seated, the thoracic and lumbar spine supported by the chair back, and the shoulder girdle stabilized to prevent compensatory motion. For flexion and extension, the goniometer axis was placed over the external auditory meatus, the proximal arm perpendicular to the ground, and the distal arm along the base of the nares; a tongue depressor held between the teeth served as a reference where needed. For lateral flexion, the axis was positioned over the C7 spinous process, the proximal arm along the thoracic spinous processes, and the distal arm along the dorsal midline of the head toward the occipital protuberance. For rotation, the axis was placed over the center of the cranial aspect of the head, the proximal arm parallel to an imaginary line between the acromial processes, and the distal arm toward the tip of the nose. Three repetitions were performed and the mean value recorded.

Reference values were 50° for flexion, 80° for extension, 85° for rotation to each side, and 45° for lateral flexion to each side, based on published normative data. Pain intensity was assessed with a 10-point visual analogue scale (VAS), anchored by "no pain" (0) and "worst pain imaginable" (10).

Statistical Analysis

Descriptive statistics summarized the sample. One-sample t-tests compared the mean of each ROM movement against its reference value, and Pearson correlation coefficients examined associations between ROM and VAS pain intensity. Statistical significance was set at $p < 0.05$. Analyses were performed with SPSS.

RESULTS

All 29 patients completed the assessment (22 men, 75.9%; 7 women, 24.1%). Mean pain intensity was 6.28 ± 2.03 (range 2-10) (Table 1).

Table 1: Descriptive statistics of cervical range of motion and pain intensity (N=29).

Movement	Minimum	Maximum	Mean	SD
Flexion (°)	13.00	50.00	33.59	7.69
Extension (°)	18.00	45.00	30.59	6.22
Right rotation (°)	22.00	65.00	36.59	11.47
Left rotation (°)	20.00	75.00	36.76	11.60
Right lateral flexion (°)	19.00	77.00	33.86	13.24
Left lateral flexion (°)	18.00	55.00	32.76	8.89
Pain intensity (VAS 0–10)	2.00	10.00	6.28	2.03

Every cervical movement was significantly restricted compared with its reference value (all $p < 0.001$; Table 2, Figure 1). The largest absolute deficits were observed in extension (−49.4° below the reference) and rotation (−48.4°), while lateral flexion showed the largest relative deficit relative to the expected arc. No participant achieved the reference value for flexion, extension, or rotation; only isolated patients reached the reference for lateral flexion.

Table 2: One sample t-tests of cervical range of motion against reference values.

Movement	Reference	Mean difference	t(df=28)	p
Flexion	50	−16.41	−11.49	< 0.001
Extension	80	−49.41	−42.79	< 0.001
Right rotation	85	−48.41	−22.74	< 0.001
Left rotation	85	−48.24	−22.40	< 0.001
Right lateral flexion	45	−11.14	−4.53	< 0.001
Left lateral flexion	45	−12.24	−7.42	< 0.001

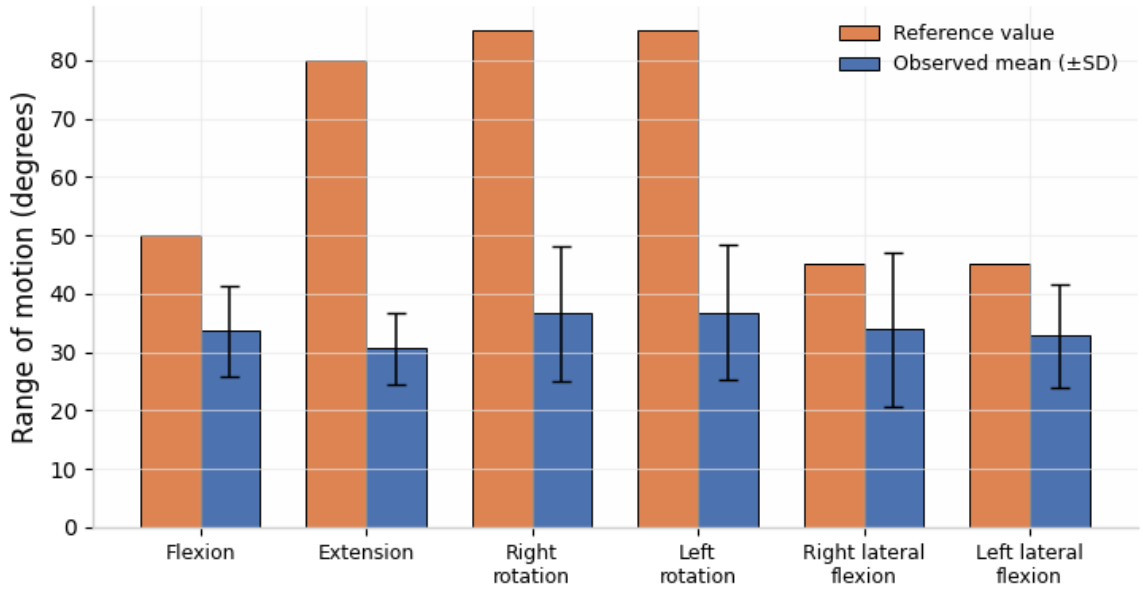


Fig. 1: Observed mean cervical range of motion (±SD) versus reference values for the six movements.

Correlations between ROM and pain intensity were weak and predominantly non-significant (Table 3). Right lateral flexion showed a borderline inverse association (r = −0.345, p = 0.067), while flexion (r = −0.065, p = 0.736), extension (r = −0.214, p = 0.266), right rotation (r = −0.068, p = 0.724), left rotation (r = −0.021, p = 0.913), and left lateral flexion (r = −0.182, p = 0.345) were not significantly correlated with pain. The directions were uniformly inverse, indicating a consistent but weak tendency for more painful patients to move less.

Table 3: Pearson correlations between cervical range of motion and pain intensity (n=29).

Movement	R with pain	p
Flexion	−0.065	0.736
Extension	−0.214	0.266
Right rotation	−0.068	0.724
Left rotation	−0.021	0.913
Right lateral flexion	−0.345	0.067
Left lateral flexion	−0.182	0.345

DISCUSSION

This study demonstrates that Libyan patients with chronic neck pain exhibit profound restriction of active cervical motion in all planes, with extension and rotation particularly affected. The magnitude of the restriction nearly 50 degrees below the reference for extension and rotation exceeds what might be attributed to pain-related guarding alone and suggests a global loss of cervical mobility consistent with the chronicity of the condition. These results align with the broader literature describing measurable physical impairment, including reduced ROM, altered sensory function, and psychosocial disturbance, in chronic neck pain populations. [9,11,13]

An important and somewhat unexpected finding was the weakness of the correlation between ROM and pain intensity. Although every correlation was inverse more pain, less motion none reached significance except a borderline trend for right lateral flexion. This pattern mirrors previous observations that physical measures correlate only modestly with self-reported pain and disability, and it carries a practical message: restricted ROM should be interpreted as a marker of overall functional impairment rather than as a proxy for pain severity in the individual patient. This supports

recommendations that ROM be complemented by pain, disability, and psychosocial measures in comprehensive assessment. [4,15]

The weak correlation between subjective pain intensity and objective range of motion observed in this study is consistent with recent large-scale meta-analytic findings.[15] Soltanabadi et al. demonstrated that active cervical ROM exhibits only modest associations with self-reported pain intensity and functional disability in persistent musculoskeletal neck disorders. [15] This divergence highlights that pain intensity and joint mobility evaluate distinct dimensions of chronic pain; while joint range reflects mechanical capacity and tissue tolerance, pain intensity represents a multidimensional perceptual phenomenon influenced by central nociceptive processing. [7,15]

The structural disconnect between pain perception and physical performance underscores the clinical necessity of adopting multi-domain evaluation frameworks. Relying solely on ROM as a primary surrogate marker for therapeutic success risks misinterpreting clinical progress. [4,15] Comprehensive clinical pathways should systematically pair goniometric tracking with patient-reported functional outcomes, neck disability metrics, and psychological screenings to ensure a balanced evaluation of rehabilitation efficacy. [6,8,15]

The clinical implication is twofold. First, the large mean deficits, particularly in extension and rotation, argue for interventions that specifically target restoration of these movements; exercise programs have consistently been shown to improve pain and function in chronic neck pain, and gains in ROM are a plausible mechanistic component. [9-13] Second, because pain and motion appear to behave as partially independent dimensions, treatment success should be judged on both outcomes rather than on ROM alone.

The sample was small (n = 29), predominantly male, and recruited by convenience from two private clinics in a single city, limiting external validity. Goniometry, although reliable, is examiner-dependent. No asymptomatic control group was included, so conclusions rest on comparisons with published normative values, which vary across ages and populations. The cross-sectional design precludes any causal inference about whether restriction precedes or follows pain chronification. Finally, disability, psychological factors, and activity levels were not measured, and these may mediate the observed relationships.

CONCLUSION

Active cervical range of motion is markedly restricted in all directions in Libyan patients with chronic neck pain, with extension and rotation most severely affected. However, pain intensity correlates only weakly and mostly non-significantly with the degree of restriction. Clinicians should therefore assess ROM and pain as complementary not interchangeable outcomes, and should combine goniometric measurement with validated pain and disability instruments when planning and evaluating rehabilitation for chronic neck pain.

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