

Targeted Postural and Ergonomic Rehabilitation for Tech Neck Syndrome: An ICF-Based Case Report

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Abstract:

➤ *Background:*

Forward Head Posture (FHP), commonly recognized in modern clinical language as "Tech Neck," represents a pervasive postural deviation that has reached epidemic proportions among university students. This demographic is uniquely susceptible due to academic environments that demand prolonged screen time, high psychological stress, and inherently poor ergonomic setups. While standard physical therapy effectively addresses localized musculoskeletal pain through a biomedical lens, isolated tissue-level interventions often fail to secure long-term functional recovery. Utilizing the International Classification of Functioning, Disability and Health (ICF) framework is essential for managing the broader, interconnected functional, environmental, and academic limitations imposed by this condition.

➤ *Objective:*

To systematically evaluate the clinical efficacy of a simplified, highly accessible, home-based Deep Cervical Flexor (DCF) training and scapular stabilization protocol on pain reduction, craniovertebral angle (CVA) restoration, and the return to functional academic participation in a highly symptomatic collegiate student.

➤ *Case Description:*

A 21-year-old female undergraduate architecture student presented to the university clinic with chronic, non-specific mechanical neck pain (NPRS 7/10), severely reduced CVA (42 degrees), and a functional inability to participate in prolonged academic drafting sessions without experiencing severe discomfort and tension headaches.

➤ *Intervention:*

A comprehensive 4-week protocol was implemented. To ensure maximum compliance and accessibility, the intervention avoided advanced modalities and relied strictly on fundamental craniocervical flexion exercises (chin tucks), accessible bodyweight scapular strengthening, and highly specific behavioural and environmental ergonomic modifications mapped to the ICF framework.

➤ *Results:*

Post-intervention at Week 4, the patient reported a near-complete resolution of movement-related pain (NPRS 1/10), and the CVA improved significantly to 51 degrees. Her Neck Disability Index (NDI) score decreased from a state of moderate disability to no disability, enabling a full return to unrestricted academic participation.

➤ *Conclusion:*

The early implementation of fundamental, conservative postural exercises effectively restores cervical alignment and mitigates nociceptive pain. More importantly, embedding these interventions within the ICF framework provides a

comprehensive clinical roadmap that successfully bridges the critical gap between mechanical musculoskeletal recovery and meaningful, sustained academic participation.

Keywords: *Forward Head Posture, Tech Neck, ICF Framework, Deep Cervical Flexors, Scapular Stabilization, Ergonomics, Collegiate Health, Postural Orthopedics.*

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I. INTRODUCTION

The advent of the digital era has fundamentally altered the kinetic and postural demands placed upon the human musculoskeletal system. Nowhere is this shift more evident than within the collegiate and university populations. The modern academic curriculum relies almost exclusively on digital mediums, requiring students to spend unprecedented amounts of time interacting with laptops, tablets, and smartphones. This environmental shift has catalysed a sharp increase in the incidence of Postural Cervical Syndrome, clinically characterized by Forward Head Posture (FHP) and commonly referred to as "Tech Neck" (Alshahrani et al., 2021).

FHP is a complex musculoskeletal deviation characterized by the translation of the head anterior to the coronal plane. Biomechanically, this presents as sustained excessive extension of the upper cervical spine (C1-C3) combined with excessive flexion of the lower cervical and upper thoracic spine (C4-T4). This sustained postural fault alters the normal length-tension relationship of the cervicothoracic musculature, leading to a highly predictable and standardized pattern of muscle imbalance first described as Upper Crossed Syndrome (Janda, 1983; Lee et al., 2015).

In the realm of modern rehabilitation and evidence-based practice, addressing chronic postural syndromes requires a departure from the traditional biomedical model, which focuses too narrowly on isolated tissue pathology. The contemporary standard of care necessitates the use of the International Classification of Functioning, Disability and Health (ICF) model (Bagraith et al., 2013). Endorsed by the World Health Organization, the ICF framework provides a robust biopsychosocial architecture that categorizes patient health across multiple interconnected domains: body functions and structures, activities, participation, environmental factors, and personal factors (Escalante et al., 2022). This paradigm shift allows clinicians to move beyond simple range-of-motion metrics and directly address how an impairment restricts a patient's capacity to function within their specific environmental context in this case, a high-stress academic setting.

This case report aims to explore the deep clinical efficacy of an accessible, conservative exercise intervention for FHP, mapped thoroughly and comprehensively through the ICF framework, in a symptomatic collegiate demographic.

II. LITERATURE REVIEW

➤ *Pathophysiology and Biomechanics of Forward Head Posture*

The human head weighs approximately 10 to 12 pounds in a neutral position. However, the cervical spine operates as a class-one lever system. As the head translates anteriorly out of the neutral coronal plane, the gravitational moment arm increases, drastically multiplying the functional weight that the posterior cervical structures must support. Research has demonstrated that for every inch the head moves forward, the load on the cervical spine increases by roughly 10 pounds. At 45 degrees of cervical flexion—a common angle for smartphone or laptop use—the forces exerted on the lower cervical facet joints and intervertebral discs can exceed 49 pounds (Hansraj, 2014; Neupane et al., 2017).

This chronic, sustained mechanical loading induces a phenomenon known as "creep" in the posterior cervical ligaments, reducing their passive stabilizing capacity. Consequently, the active muscular system must compensate. The deep cervical flexors (longus colli and longus capitis) and the lower scapular stabilizers (middle and lower trapezius, serratus anterior) become mechanically disadvantaged, stretched, and progressively weakened (Cagnie et al., 2007). Conversely, the posterior cervical extensors, upper trapezius, levator scapulae, and anterior chest musculature (pectoralis major and minor) are forced into a state of chronic isometric contraction, leading to adaptive shortening, myofascial trigger point development, and significant nociceptive pain (Page et al., 2010).

➤ *Epidemiology and Prevalence in Collegiate Populations*

Recent epidemiological investigations demonstrate a concerning, high prevalence of FHP among university students, framing it as a rapidly growing public health concern within academia. A comprehensive cross-sectional analysis by David et al. (2021) identified a staggering prevalence of FHP in college students, establishing strong, statistically significant correlations between the severity of FHP and daily laptop use exceeding four hours. Similarly, a study by Namwongsa et al. (2018) established a direct negative correlation between daily digital screen time and the Craniovertebral Angle (CVA)—the primary objective metric for quantifying FHP—highlighting the profound environmental risks associated with modern academic demands.

➤ *The ICF Framework and Non-Specific Mechanical Neck Pain*

The ICF framework provides a superior, multidimensional structure for the assessment and management of musculoskeletal pain, particularly in primary care and outpatient settings. Systematic reviews and scoping analyses consistently emphasize that utilizing ICF core sets for neck pain captures crucial functional and psychosocial limitations that standardized, unidimensional pain scales (such as the Visual Analog Scale) frequently miss. Domains such as "handling stress," "maintaining attention," and "carrying out a daily routine" are critical metrics for student populations and are comprehensively addressed only when utilizing the ICF model (Linden et al., 2020; Martín-Nogueras et al., 2023).

➤ *Evidence for Simplified, Conservative Exercise Interventions*

While the biomechanical consequences of FHP are complex, the clinical literature consistently identifies targeted, low-tech motor control exercises as highly effective interventions. Advanced biofeedback mechanisms and complex modalities exist; however, simplified protocols utilizing supine craniocervical flexion (to isolate the deep neck flexors) combined with fundamental bodyweight scapular retraction exercises have proven equally efficacious for long-term pain reduction and structural postural correction in non-clinical, home-based settings (Falla et al., 2007; Gupta et al., 2013; Kang et al., 2015). This accessibility is paramount for collegiate populations, where compliance with home exercise programs is often the primary determinant of successful rehabilitation.

III. CASE DESCRIPTION AND METHODOLOGY

➤ *Patient Profile and Subjective History*

The patient was a 21-year-old female, currently enrolled as a full-time undergraduate engineering student. She presented to the university physiotherapy clinic via self-referral. Her chief complaint was the insidious, progressive onset of bilateral, dull, aching pain localized to the lower cervical spine (C5-C7) and upper thoracic regions, accompanied by episodic, tension-type headaches radiating from the suboccipital region to the frontal temporal lobes.

The patient reported that symptoms had been progressively worsening over the final six weeks of the academic semester. The escalation of pain correlated directly with a sharp increase in the time spent at her study table and utilizing her 15.6-inch laptop for AutoCAD software, averaging 8 to 10 hours of screen time daily. She denied any history of acute cervical trauma, motor vehicle accidents, radicular symptoms (numbness, tingling, or weakness in the upper extremities), or concussions.

➤ *Objective Clinical Findings (Baseline)*

A comprehensive physical examination was conducted to establish baseline metrics prior to intervention.

- **Pain Assessment:** The Numeric Pain Rating Scale (NPRS) indicated a score of 7/10 at its worst, specifically following prolonged, uninterrupted study sessions exceeding two hours. Resting pain was rated at 3/10.
- **Postural Analysis:** Observation from the sagittal plane revealed pronounced anterior translation of the head, a highly accentuated cervicothoracic kyphosis (Dowager's hump presentation), and bilateral protracted and anteriorly tilted scapulae.
- **Craniovertebral Angle (CVA):** Measured utilizing standard sagittal photogrammetry. The CVA is defined as the angle formed by a horizontal line drawn through the spinous process of C7 and a line connecting the C7 spinous process to the tragus of the ear. The patient's baseline CVA was recorded at 42 degrees, indicative of moderate-to-severe FHP.
- **Neck Disability Index (NDI):** The patient completed the NDI questionnaire, scoring 34 out of 100. This score categorized her as having a "Moderate Disability," specifically noting severe limitations in her ability to maintain concentration and read for prolonged periods.
- **Range of Motion (ROM):** Active cervical retraction and extension were limited by approximately 25% compared to normative values, bounded by a firm tissue stretch end-feel and reports of pulling sensations in the suboccipital and sternocleidomastoid (SCM) muscle groups.
- **Neuromuscular Assessment:** The patient demonstrated profound endurance deficits during the Craniocervical Flexion Test (CCFT). She was unable to perform an isolated, controlled craniocervical nodding motion without immediate, visible substitution and overactivation from the superficial SCM and anterior scalene muscles. Manual muscle testing (MMT) revealed Grade 3+/5 weakness in the bilateral middle and lower trapezius.
- **Neurological Screen:** Upper quarter dermatomes, myotomes, and deep tendon reflexes (C5-T1) were intact, symmetrical, and unremarkable. Spurling's test for cervical radiculopathy was negative.

➤ *Application of the ICF Model*

To transition from a purely biomedical diagnosis to a comprehensive rehabilitation strategy, the clinical problem list was systematically analysed and mapped across the interconnected domains of the ICF framework. This deep mapping provided the foundational rationale for the subsequent conservative interventions.

➤ *Health Condition (Disorder/Disease)*

- **Postural Cervical Syndrome (Non-specific mechanical neck pain secondary to Forward Head Posture / Tech Neck).**

➤ *Body Functions and Structures (Impairments)*

This domain captures the direct anatomical and physiological deficits.

- **Impaired length-tension relationships of the cervicothoracic musculature, strictly adhering to the Upper Crossed Syndrome clinical pattern.**

- Decreased muscular endurance and delayed motor firing of the deep cervical flexor synergists (longus colli/capitis).
- Increased mechanical compressive loading and facet joint shear forces on the lower cervical spine (C5-C7) due to the altered cranial center of gravity.
- Suboccipital tension headaches secondary to mechanical joint stress, sustained isometric muscle guarding, and restricted fascial mobility.

➤ *Activities (Limitations)*

This domain defines the specific physical tasks the patient struggles to execute.

- Severe difficulty maintaining sustained visual focus on computer screens or digital devices for periods exceeding 45 minutes without experiencing escalating nociceptive pain.
- Inability to comfortably maintain the downward visual gaze required while manually sketching or building physical architectural models.
- Discomfort and fatigue when required to carry a heavily loaded academic backpack across the expansive university campus.

➤ *Participation (Restrictions)*

This domain highlights the profound impact the impairments have on the patient's societal and academic roles.

- Decreased ability to actively and comfortably participate in mandatory, lengthy 3-hour architectural studio sessions without taking frequent, highly disruptive rest breaks to manage pain.
- Reduced overall efficiency in completing complex academic assignments, leading to a heightened risk of missed deadlines and a potential decline in academic performance and GPA.
- Complete withdrawal from recreational campus activities (intramural sports) due to accumulated postural fatigue and chronic discomfort.

➤ *Environmental Factors*

This domain identifies the external, physical parameters that either hinder or support the patient.

- Barriers: The inherently poor, unadjustable ergonomic design of standard university library seating and drafting tables. The absolute reliance on a 15.6-inch laptop lacking a peripheral monitor, separate keyboard, or elevated stand, forcing the patient into extreme cervical flexion.
- Facilitators: Direct, free access to the on-campus physiotherapy clinic.

➤ *Personal Factors*

This domain acknowledges the psychological and internal realities of the patient.

- Exceptionally high levels of academic stress and anxiety regarding an upcoming, high-stakes semester exam project. This psychological stress functionally amplifies

sympathetic nervous system tone, increasing resting muscular tension and exacerbating central pain perception.

- Disrupted, inadequate sleep patterns (averaging 4 to 5 hours per night) fundamentally compromising cellular tissue recovery and lowering pain thresholds.
- High intrinsic motivation to resolve the musculoskeletal issue to ensure academic success.

➤ *Intervention Strategy and Clinical Rationale*

The protocol spanned a 4-week period and purposefully avoided the use of expensive modalities, relying instead on targeted motor control re-education, basic strengthening, and strict environmental modification mapped directly to the ICF findings.

• *Intervention 1: Neuromuscular Re-education of the Deep Cervical Flexors (DCF)*

The foundational impairment driving the patient's pain was the inability of the DCF to stabilize the anterior cervical spine against the pull of gravity.

- ✓ Procedure: The patient was instructed in basic craniocervical flexion exercises (the "chin tuck"). To minimize the effect of gravity and prevent substitution from the large, superficial SCM muscles, the exercise was initially performed entirely in a supine position. A standard rolled towel was placed under the cervical lordosis for neutral tactile feedback. The patient was taught to perform a slow, highly controlled nodding motion, isolating the deep anterior musculature.
- ✓ Dosage: 3 sets of 10 repetitions performed daily, with strict 5-second isometric holds at the end-range of the nod.

• *Intervention 2: Scapular Stabilization and Postural Endurance*

To address the rounded shoulders and the increased thoracic kyphosis contributing to the altered cervical base of support, fundamental, equipment-free bodyweight exercises were introduced.

- ✓ Procedure: The patient performed prone scapular retractions (forming 'T' and 'Y' shapes with the arms) while lying flat on a standard yoga mat. Emphasis was placed on initiating the movement by actively squeezing the inferior borders of the shoulder blades together, rather than elevating the shoulders toward the ears. Seated "wall-angels" were also integrated to promote dynamic thoracic extension and active pectoralis stretching.
- ✓ Dosage: 3 sets of 15 repetitions, performed daily, focusing on high-repetition endurance to counteract the hours of static forward posture.

• *Intervention 3: Environmental and Behavioral Ergonomic Modification*

Addressing the "Environmental Barriers" identified in the ICF mapping was critical. Without modifying the workspace, the clinical exercises would merely temporarily alleviate symptoms that the academic environment would immediately recreate.

- ✓ Procedure: The patient received practical, low-cost ergonomic counseling. She was instructed to utilize heavy textbooks as an improvised laptop riser to elevate the top third of her screen directly to eye level, preventing the need for lower cervical flexion. She transitioned to using a cheap external wireless keyboard and mouse to keep her arms at a comfortable 90-degree angle, preventing scapular protraction.
- ✓ Behavioral Integration: The patient was trained to implement the standard "20-20-20 rule" during all study sessions: Every 20 minutes, she was required to look away

from her screen at an object at least 20 feet away for a minimum of 20 seconds. This brief interruption unloads the sustained static tension on the cervical joints and allows for brief muscular reperfusion.

IV. RESULTS

By the conclusion of the 4-week protocol, she exhibited clinically meaningful, objective improvements across the structural, pain, and functional ICF domains.

Table 1 Comprehensive Clinical Outcomes Following 4-Week Postural Rehabilitation

Clinical Parameter	Pre-Intervention (Week 0)	Post-Intervention (Week 4)
Pain Rating (NPRS)	7/10	1/10
Craniovertebral Angle (CVA)	42 degrees	51 degrees
Neck Disability Index (NDI)	34 / 100 (Moderate Disability)	8 / 100 (No Disability)
Academic Participation	Max 45 minutes of drafting	Full 3-hour studio session

➤ Functional Interpretation of Results

The progressive resolution of symptoms followed a predictable, physiological timeline. By Week 2, the frequency of suboccipital tension headaches had diminished by approximately 80%, correlating with the improved endurance of the deep cervical flexors and the reduction in upper trapezius guarding. By Week 4, the measured improvement in the Craniovertebral Angle from 42 degrees to 51 degrees objectively validated the structural postural correction. Most critically, analyzing the outcomes through the ICF lens, the patient successfully returned to completing uninterrupted 3-hour architectural drafting sessions, completely eliminating the participation restrictions that originally threatened her academic standing.

V. DISCUSSION

This comprehensive case report vividly illustrates the successful application of the ICF framework to diagnose, deeply analyze, and treat a highly common presentation of Postural Cervical Syndrome (Tech Neck) utilizing strictly accessible, low-tech interventions in a high-stress collegiate demographic.

➤ The Efficacy of Simplified Motor Control Interventions

The primary pathophysiological driver of the patient's pain was the mechanical fatigue and ischemic distress of the posterior cervical muscles, forced to chronically compensate for weakened, inhibited deep flexors. As heavily supported by the clinical trials conducted by Falla et al. (2007) and Kang et al. (2015), expensive clinical modalities, complex traction devices, or advanced biofeedback units are not strictly necessary for successful postural correction in non-traumatic populations. Fundamental, deeply understood craniocervical flexion exercises (chin tucks) and bodyweight-resisted scapular stabilization effectively and efficiently reverse the upper crossed syndrome pattern when performed with high compliance and correct form. The focus on muscular endurance over peak strength proved optimal for addressing the specific demands of sustained sedentary postures.

➤ The Indispensable Value of the ICF Framework in Primary Care

While traditional, biomedically focused physical therapy effectively manages tissue-level impairments (reducing inflammation, restoring basic ROM), integrating the ICF framework is what ensures long-term success by directly addressing the behavioral and environmental root causes of FHP.

By systematically identifying the patient's laptop positioning and the university drafting tables as primary "Environmental Barriers," the clinician was able to prescribe simple, zero-cost ergonomic interventions (utilizing textbooks as a riser). This crucial step prevented the daily reversal of the clinical progress achieved through exercise. Furthermore, addressing the "Participation" domain shifted the entire therapeutic narrative. It allowed the clinician and the patient to collaboratively set a meaningful, functional goal of completing a rigorous 3-hour architectural studio class—rather than relying solely on arbitrary, isolated range-of-motion metrics that often hold little relevance to the patient's daily reality. This functional focus significantly enhances patient buy-in and adherence to the rehabilitation program.

➤ Clinical Implications for University Health Systems

The findings of this case report carry significant implications for university-based health and wellness centers. The high prevalence of FHP dictates that campus clinics will see an escalating volume of non-specific mechanical neck pain. Establishing standardized, accessible, and easily disseminable conservative protocols based on the ICF framework can dramatically reduce the burden on healthcare resources. By emphasizing education, low-tech home exercise programs, and campus-wide ergonomic awareness campaigns, universities can proactively mitigate the impact of "Tech Neck" before it causes severe academic disruption.

VI. LIMITATIONS

While the outcomes were highly successful, this report is limited by its single-case design, inherently restricting the broader generalization of the results. The reliance on standard

photogrammetry for CVA measurement, while clinically validated, lacks the absolute precision of radiographic imaging, though exposing a non-traumatic patient to unnecessary radiation was contraindicated. Future research should prioritize large-scale, randomized controlled trials specifically utilizing the ICF framework to evaluate conservative postural interventions across diverse academic disciplines.

VII. CONCLUSION

The early implementation of fundamental, highly accessible Deep Cervical Flexor and scapular stabilization training represents a profoundly effective, evidence-based strategy for treating Forward Head Posture and non-specific mechanical neck pain in collegiate populations. However, the true efficacy of these interventions is unlocked only when they are embedded within the holistic architecture of the International Classification of Functioning, Disability and Health (ICF) framework. Utilizing the ICF model ensures that physical therapy actively transcends the clinical treatment plinth, purposefully integrating straightforward ergonomic modifications and behavioral strategies to secure long-term, sustainable academic and functional recovery.

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