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Exploring the Frontier of Digital Therapy: An In-Depth Analysis Effectiveness of Telerehabilitation in Alleviating Chronic Neck Pain

Mansi¹, Ankita Sharma¹, Sumbul Zaidi², Moattar Raza Rizvi^{3*}

¹ Department of Physiotherapy, School of Allied Health Sciences, Manav Rachna International Institute of Research & Studies (MRIIRS), Faridabad, Haryana 121004, India

² Council for Doctoral Program (CDP) Cell, Manav Rachna International Institute of Research & Studies (MRIIRS), Faridabad, Haryana 121004, India

³ Research & Development Cell, Manav Rachna International Institute of Research & Studies (MRIIRS), Faridabad, Haryana 121004, India

*Corresponding Author: mrrizvi.fas@mriu.edu.in

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Abstract

Background: Telerehabilitation has emerged as a viable alternative to conventional therapy for managing Chronic neck pain (CNP), especially in cases related to poor posture. The study aimed to compare the effectiveness of telerehabilitation and conventional therapy in reducing functional disability, pain intensity, and improving craniovertebral angle in individuals with CNP due to poor posture. **Methodology:** This study employed a pre-post experimental design with 40 participants suffering from CNP, divided into conventional therapy and telerehabilitation groups. Outcomes measured were functional disability (NPAD), pain intensity (NPRS), and craniovertebral angle before and after a 4-week intervention period. **Results:** Significant improvements were observed in both groups. In the conventional therapy group, NPAD scores decreased from 33.9 ± 4.47 to 25.4 ± 2.56 ($t=2.91$, $p<0.001$), and in the telerehabilitation group from 32.35 ± 3.66 to 24.9 ± 2.29 ($t=2.46$, $p<0.001$). NPRS scores in the conventional therapy group reduced from 6.15 ± 0.81 to 4.05 ± 0.83 ($t=0.31$, $p<0.001$), and in the telerehabilitation group from 6.05 ± 0.94 to 3.85 ± 0.93 ($t=0.52$, $p<0.001$). Craniovertebral angle showed a significant increase in the conventional therapy group from 33.16 ± 5.77 to 42.43 ± 4.81 ($t=2.33$, $p<0.001$) and in the telerehabilitation group from 33.27 ± 5.56 to 38.55 ± 5.62 ($t=4.37$, $p<0.001$). **Conclusion:** Both conventional therapy and telerehabilitation were effective in significantly reducing functional disability and pain intensity, with notable improvements in craniovertebral angle, suggesting that telerehabilitation can be a potent alternative to conventional therapy for managing CNP due to poor posture.

Keywords: Chronic Neck Pain, Telerehabilitation, Conventional Therapy, Functional Disability, Pain Intensity, Craniovertebral Angle

Introduction

Chronic neck pain (CNP), which persists for three months or longer, is a prevalent and debilitating condition, primarily affecting the area between the occipital condyle and the seventh cervical vertebra (C7). Research by Jensen and Harms-Ringdahl (2007) and Gummesson et al. (2006) highlights the anatomical focus of CNP, underscoring its significance in clinical diagnosis and treatment. The increasing incidence of CNP, with estimates suggesting that between 48% and 67% of the population will experience neck pain at some point in their lives (Cote, Cassidy, and Carroll, 1998; Takasawa et al., 2015), points to a growing public health concern.

Patients with CNP often experience difficulties in maintaining an upright posture, accompanied by a forward drift of the head, symptoms that indicate a possible impairment in the muscle endurance needed for spinal stability (Hanten et al., 2000; Szeto, Straker, and O'Sullivan, 2005). Furthermore, alterations in the sagittal cervical curve, particularly the loss of cervical lordosis, have been implicated in the pathophysiology of neck pain, emphasizing the need for targeted therapeutic interventions (Falla et al., 2007; Szeto, Straker, and O'Sullivan, 2005). The biopsychosocial model of care suggests that active interventions, including educational programs, exercise therapy, and functional training, should be integral to the management strategies for neck disorders (Scholten-Peeters et al., 2002).

Neck pain is understood as a multifactorial ailment, influenced by physical workloads, ergonomic stress, and psychosocial factors, among others. The ubiquity of neck pain, whether transient or persistent, necessitates a comprehensive approach to its management, including posture correction and targeted exercises to prevent the onset of chronic symptoms. Prolonged static postures, particularly in occupational settings, have been linked to increased muscle strain and the risk of developing upper body symptoms, highlighting the importance of ergonomic interventions in the prevention and management of neck pain (Akshay Bansode & Deepali Hande et al., 2016). The prevalence of CNP is anticipated to rise further, especially in the context of an increasingly sedentary lifestyle and the widespread use of computer technology in the workplace. This trend underscores the critical need for effective management strategies to alleviate symptoms,

prevent recurrence, and minimize the broader socio-economic impacts of neck pain. The craniovertebral angle (CVA) is a key metric for assessing neck posture, with reduced values indicating a higher likelihood of forward head posture and associated disability (Bulk et al., 2018; Suvarnato, 2019; Dias et al., 2021).

Addressing neck pain effectively requires a nuanced understanding of its etiology, including muscle strains, nerve compression, and the potential for traumatic injuries, all of which can contribute to the chronicity of symptoms. The persistent nature of neck pain, often lasting for months and signaling deeper medical concerns, necessitates a patient-centered approach to healthcare design and delivery. This approach should accommodate patients' preferences and needs, particularly in the realm of tele-rehabilitation, an area that remains underexplored despite its potential to transform pain management practices (Bulk et al., 2018; Fiani et al., 2020).

While existing literature extensively discusses the prevalence and physical management of CNP, there is a discernible gap in understanding the optimal integration of technological solutions, specifically telerehabilitation, in managing this condition. The advent of telehealth has revolutionized the approach to chronic pain management, offering remote, accessible, and patient-centered care options. However, the literature remains sparse on comprehensive analyses that juxtapose the effectiveness of telerehabilitation with traditional therapy modalities in treating CNP. Additionally, there is a lack of detailed exploration into patients' preferences and the effectiveness of human versus electronic interaction in the rehabilitation process for neck pain (Bulk et al., 2018; Fiani et al., 2020).

Tele-rehabilitation, defined as the provision of rehabilitative services through telecommunication technologies, offers a promising avenue for delivering patient-centered care, transcending physical, geographical, and financial barriers. The integration of tele-rehabilitation into pain management protocols, especially for musculoskeletal conditions, has gained traction, driven by the restrictions of the recent pandemic and the growing recognition of its benefits in ensuring continuity of care (Dias, 2021; alVieira et al., 2022). The advent of tele-rehabilitation has opened new avenues for managing conditions like stroke, musculoskeletal disorders, chronic pain, and mental health issues, offering a range of services from

physical and occupational therapy to speech therapy and counseling. The potential of tele-rehabilitation to provide accessible care to patients in remote or underserved areas signifies a paradigm shift in healthcare delivery, emphasizing the need for robust research to evaluate its effectiveness compared to traditional therapeutic modalities.

This study seeks to fill a critical gap in the literature by comparing the efficacy of tele-rehabilitation and conventional therapy in managing CNP, particularly focusing on interventions like isometric exercises, stretching techniques, and ergonomic adjustments. By analyzing the outcomes of these interventions in both tele-rehabilitation and conventional therapy settings, the study aims to elucidate the most effective strategies for improving patient outcomes, enhancing clinical decision-making, and ultimately, advancing the field of pain rehabilitation.

Methodology

Study Design

This study adopted a quasi-experimental pre-post design to assess the efficacy of telerehabilitation and conventional therapy in mitigating functional disability, alleviating pain intensity, and enhancing craniovertebral angle among faculty members afflicted with neck pain attributed to suboptimal posture. A convenience sampling strategy was utilized to recruit participants from the faculty cohort engaged in prolonged computer usage. Initial assessments were conducted to establish baseline metrics for functional disability, pain intensity, and craniovertebral angle. Following this, the respective interventions were implemented. Subsequent evaluations were performed post-intervention to ascertain the interventions' impact. The study's design facilitated intra-subject comparisons, thereby enabling the determination of the therapeutic interventions' effectiveness in ameliorating the specified health outcomes.

Study Setting

The research was conducted at Manav Rachna University, chosen for its accessible population of computer users, many of whom experience CNP due to prolonged periods of computer use. The university setting provided a controlled environment conducive

to monitoring the participants' progress and ensuring adherence to the intervention protocols.

Participants were randomly assigned to either the telerehabilitation group or the conventional therapy group. The study's experimental nature allowed for a direct comparison of the outcomes of each treatment modality on CNP.

Study Duration

The intervention period spanned four weeks, a duration deemed sufficient to observe significant changes in symptoms and assess the short-term efficacy of the respective treatments. This timeframe facilitated a focused and intensive intervention protocol, ensuring consistent engagement from the participants.

Sample Size

The sample size for the study was calculated using G*Power software, a common tool for power analysis in quantitative research. For the statistical test of the means difference between two dependent means (matched pairs), which is appropriate for comparing pre- and post-intervention effects within the same subjects, the following parameters were set: The analysis was conducted using a two-tailed test with an effect size (d) of 0.5, an alpha error probability (α) of 0.05, and a desired power ($1-\beta$ error probability) of 0.95. The power analysis indicated that a total sample size of 54 participants would be required to achieve the desired power, ensuring the study's capability to detect a medium-sized effect.

Participant Allocation

Participants were allocated to the study groups – Telerehabilitation (n=20) or Conventional therapy (n=20) group using a randomization process to prevent selection bias and ensure comparability between groups. The randomization was conducted through a computer-generated sequence to assign participants equally to the telerehabilitation and conventional therapy groups.

Inclusion criteria

The study will include participants aged between 25 to 40 years, as this demographic represents the working adult population most affected by chronic neck pain (CNP). To ensure the study is gender-inclusive, both

male and female participants will be recruited. The inclusion criteria target individuals who work on a computer for 4 to 6 hours daily, as this group is at a higher risk of developing CNP due to prolonged sedentary postures. Candidates must have experienced chronic neck pain for 3 months or longer, ensuring that the study addresses those with established CNP. Additionally, participants presenting with muscular pain in the neck region will be specifically included, as this is considered the most prevalent manifestation of CNP.

Exclusion criteria

Individuals presenting with vertigo will be excluded from this study due to the potential impact of this condition on balance and neck posture assessments, which are crucial for accurate evaluation of chronic neck pain (CNP). Additionally, those diagnosed with significant degenerative changes in the neck region, such as cervical spondylosis or osteoarthritis, confirmed by X-ray findings, will also be excluded to prevent the confounding effects these conditions may have on pain and posture analysis. To ensure a homogeneous study population focused specifically on CNP, individuals experiencing radiating pain from the neck to the arms or hands, which suggests potential nerve involvement, will be excluded. Similarly, participants who exhibit a positive compression test result, indicating compression of spinal nerves in the neck, will not be included in the study to maintain a focus on CNP not complicated by nerve compression issues. Furthermore, those with Posterior Intervertebral Disc Displacement (PIVD) will be excluded, as this condition may require specialized treatment that falls outside the study's scope, aiming to ensure a clear focus on CNP without overlapping with more complex spinal pathologies.

Outcome Measures

The primary outcome measure for this study was the Neck Pain and Disability Scale (NPDS), a comprehensive and validated self-reported instrument designed to assess the severity of neck pain and the extent of related functional disability. The NPDS consists of 20 items, each scored on a 6-point Likert scale ranging from 0 (no limitation or pain) to 5 (total limitation or pain), enabling the evaluation of both the intensity of neck pain and the impact on daily activities. The cumulative score of these items provides a total score, with the maximum possible

being 100, where higher scores signify greater pain severity and functional impairment (Jorritsma W, 2012)

In addition to the NPDS, the craniovertebral angle (CVA) was utilized as an objective measure to assess postural alignment, specifically the degree of forward head posture. The CVA is quantified by creating an angle between a horizontal line at the level of C7 and a line drawn from the tragus of the ear to the spinous process of the seventh cervical vertebra. This angle provides a reliable indicator of neck posture, with smaller angles indicating a greater degree of forward head posture, a common issue in individuals with chronic neck pain (Bharal S, 2023).

Pain intensity was quantitatively measured using the Numeric Pain Rating Scale (NPRS), a straightforward, single-item scale that asks participants to rate their current level of neck pain on a scale from 0 (indicating no pain) to 10 (representing the worst possible pain). The NPRS is widely used for its simplicity and sensitivity in detecting changes in pain levels over time.

Baseline measurements were taken prior to the initiation of the intervention, providing a reference point for subsequent evaluations. Follow-up assessments were then conducted at 4-week post-intervention.

Intervention Protocols

The telerehabilitation group participants received a structured rehabilitation program delivered remotely, using digital communication tools to guide exercises, provide ergonomic advice, and offer therapeutic support. These tools included video conferencing platforms for real-time interaction, which facilitated guided exercise sessions, allowed for live feedback on technique, and enabled personalized ergonomic consultations. Additionally, messages were sent to provide daily exercise routines, track progress, and offer reminders, ensuring participants remained engaged and adherent to their rehabilitation program. This comprehensive digital approach ensured that participants received consistent, tailored support throughout the program, demonstrating the versatility and effectiveness of using digital tools in delivering rehabilitation services remotely (Table 1).

The conventional therapy group underwent a traditional in-person therapy program, including

manual therapy, supervised exercises, and ergonomic training conducted within the university's physiotherapy department (Table 1).

Table 1: Comparative Overview of Interventional Programs for Chronic Neck Pain Management: Telerehabilitation vs. Conventional Therapy

Component	Telerehabilitation Group	Conventional Therapy Group
Initial Assessment	Conducted online at the start, lasting 30-60 minutes to assess baseline neck pain and functionality. Participants are taught the exercise protocol to be reminded daily through voice notes on WhatsApp.	In-person session at the beginning for 30-60 minutes to evaluate neck pain severity and functional limitations. Exercise protocol explained for daily sessions.
Exercise Program	Daily exercises performed one time per day following video instructions. Isometric exercises (neck flexion, side flexion, extension) and stretching are held for 10 seconds with 2-3 seconds relaxation, 5 repetitions each.	Daily in-person guided exercises. Isometric exercises and stretching with the same duration and repetition as Group B.
Ergonomic Training	A one-hour online workshop provided once, with weekly follow-up reminders via digital communication, covering ergonomic practices and optimal workstation setups.	One-hour in-person training session once, with weekly in-person check-ins, focused on ergonomic practices and workstation setup.
Manual Therapy	Not applicable for this group.	Provided twice a week, each session lasting 15-30 minutes, includes techniques like massage and mobilizations.
Therapeutic Support	Video consultations twice a week for 15-30 minutes, plus daily digital support for exercise reminders and progress monitoring.	In-person meetings twice a week, 15-30 minutes each, for progress assessment and therapy adjustments, supplemented by direct hands-on support.
Follow-up and Evaluation	Weekly online progress meetings, with a comprehensive virtual evaluation lasting 30-60 minutes at the end of 2 weeks.	Weekly in-person progress reviews, ending with a detailed 30-60 minute in-person evaluation after two weeks.

Statistical Analysis

The statistical analysis for this study was conducted using the SPSS 22 software package. Descriptive analysis was performed to summarize and describe the data. Mean and standard deviation were calculated for each variable within the groups. An independent t-test was performed to compare the

means of the variables between the two groups (conventional therapy and telerehabilitation). The independent t-test enabled a comparison of the effectiveness of the two treatment modalities and provided insights into any significant differences in outcomes. Furthermore, to assess the changes within each group before and after treatment, a paired t-test was employed. This test compared the means of the

pre- and post-treatment measurements for each variable within the same group.

Result

The study included two groups: the conventional therapy group and the telerehabilitation group. For the conventional group, a total of 27 participants were enrolled, comprising 11 males (40.74%) and 16 females (59.26%). In the telerehabilitation group, there were also 27 participants, with 7 males (25.93%) and a greater proportion of 20 females (74.07%). Both groups had an equal total number of participants, with a notable difference in the gender distribution; the telerehabilitation group had a higher percentage of female participants compared to the conventional group.

At the outset of the study, there were no significant differences in baseline measures between the

conventional therapy and telerehabilitation groups as indicated by independent t test (Table 2). There was no significant difference in age at the baseline between the conventional therapy group and for the telerehabilitation group ($t = 1.2, p = 0.24$), indicating a very small effect size. Neck Pain and Disability Index (NPAD) scores were also similar, with the conventional therapy group and the telerehabilitation group ($t = 1.2, p = 0.24$). The Numeric Pain Rating Scale (NPRS) scores revealed no significant initial differences between both the groups ($t = 0.36, p = 0.72$) and a negligible effect size. Craniovertebral angle (CVA) measurements, crucial for assessing neck posture, were also equivalent between groups, with the conventional therapy group averaging and the telerehabilitation group ($t = -0.06, p = 0.95$), showing an effect size close to zero. These assessments confirm that both groups were statistically indistinguishable at baseline regarding age, pain, disability, and postural alignment.

Table 2: Baseline Comparison of Age, NPAD, NPRS, and CVA between Conventional therapy and Telerehabilitation groups using independent t test

Variables	Group	Mean	SD	t	p	Cohen's d
Age	Conventional therapy Group	33.25	3.77	1.2	0.24	0.38
	Telerehabilitation Group	31.65	4.61			
NPAD	Conventional therapy Group	33.9	4.47	1.2	0.24	0.38
	Telerehabilitation Group	32.35	3.66			
NPRS	Conventional therapy Group	6.15	0.81	0.36	0.72	0.11
	Telerehabilitation Group	6.05	0.94			
CVA	Conventional therapy Group	33.16	5.77	-0.06	0.95	-0.02
	Telerehabilitation Group	33.27	5.56			

Table 3: Within Group comparison of the variables NPAD, NPRS and CV Angle from pre to post measurement

Variables	Groups	Pre	Post	Paired Differences		t	p
				Mean	SD		
NPAD	Conventional therapy group	33.9±4.47	25.4±2.56	8.50	2.91	13.06	p<0.001
	Telerehabilitation group	32.35±3.66	24.9±2.29	7.45	2.46	13.55	p<0.001
NPRS	Conventional therapy group	6.15±0.81	4.05±0.82	2.10	0.31	30.51	p<0.001
	Telerehabilitation group	6.05±0.94	3.85±0.93	2.20	0.52	18.81	p<0.001
CV Angle	Conventional therapy group	33.16±5.76	42.43±4.8	-9.27	2.33	-17.77	p<0.001
	Telerehabilitation group	33.26±5.55	38.54±5.62	-5.28	4.37	-5.41	p<0.001

The paired t-test was utilized in this study to evaluate the effectiveness of the interventions within the same group of participants (Table 3). For the Neck Pain and Disability Index (NPAD), the Conventional therapy group demonstrated a significant reduction from pre-intervention (33.9 ± 4.47) to post-intervention (25.4 ± 2.56), yielding a mean difference of 8.50, indicative of a substantial decrease in perceived pain and disability ($t = 2.91$, $p < 0.001$). The Telerehabilitation group also showed a notable improvement with scores reducing from 32.35 ± 3.66 at baseline to 24.9 ± 2.29 post-intervention, with a mean difference of 7.45 ($t = 2.46$, $p < 0.001$). These results suggest that both treatment modalities were successful in decreasing the symptoms and functional limitations associated with CNP.

In terms of pain intensity measured by the Numeric Pain Rating Scale (NPRS), the Conventional therapy group's mean scores dropped from 6.15 ± 0.81 to 4.05 ± 0.82 , with a mean difference of 2.10, reflecting a significant relief in pain ($t = 0.31$, $p < 0.001$). The Telerehabilitation group also experienced a significant decrease in pain levels, with scores decreasing from 6.05 ± 0.94 to 3.85 ± 0.93 , and a mean difference of 2.20 ($t = 0.52$, $p < 0.001$). These findings indicate that both interventions were equally effective in managing pain severity in participants.

The craniocervical angle (CVA), a measure of neck posture, showed an improvement in the Conventional therapy group with an increase from 33.16 ± 5.76 to 42.43 ± 4.80 , which corresponds to a mean difference of -9.27 ($t = 2.33$, $p < 0.001$). The Telerehabilitation group also improved, as evidenced by the increase from 33.26 ± 5.55 to 38.54 ± 5.62 , and a mean difference of -5.28 ($t = 4.37$, $p < 0.001$). This increase in CVA for both groups is suggestive of improved postural alignment after the intervention.

The application of the paired t-test and the resulting significant mean differences in both groups indicate the positive effects of the interventions on CNP. The consistent findings across all measures—NPAD, NPRS, and CVA—reinforce the conclusion that both conventional therapy and telerehabilitation can be effective modalities for improving clinical outcomes in individuals with CNP. The greater mean difference observed in the Conventional therapy group for CVA suggests a slightly more pronounced improvement in posture when compared to the Telerehabilitation group. However, both modalities demonstrated

efficacy in reducing pain and improving functional capacity and posture among individuals with CNP.

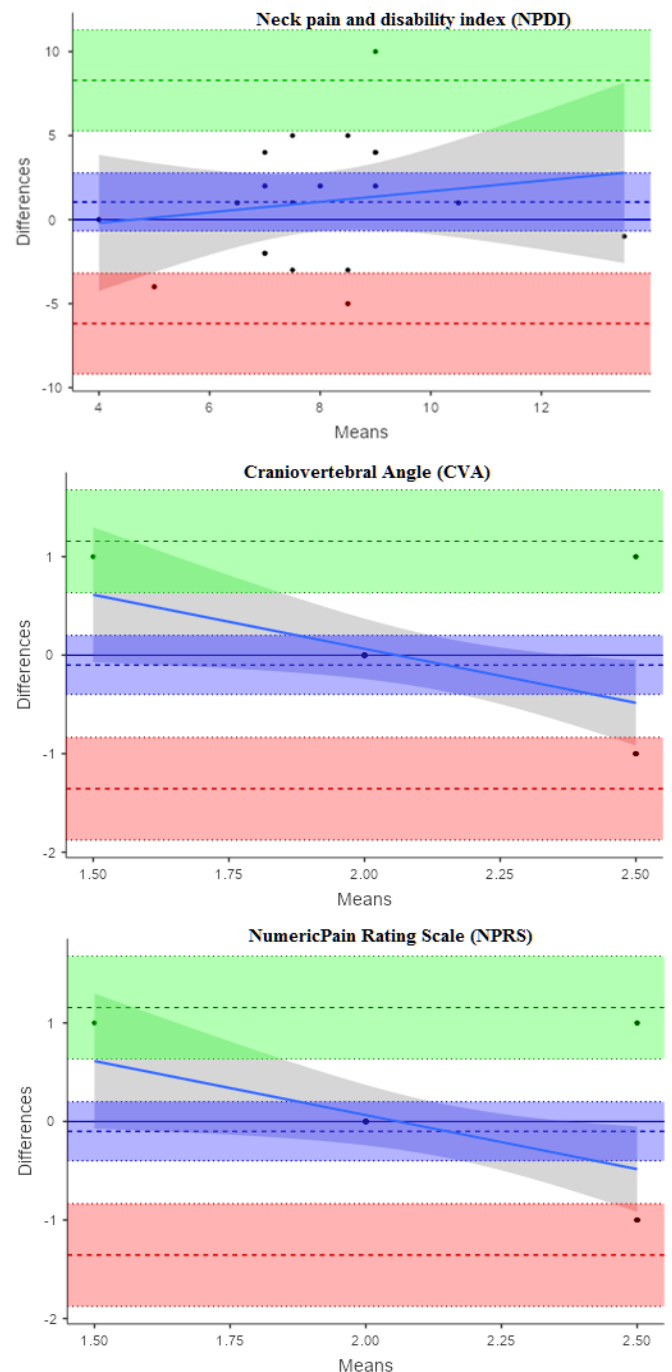


Fig. 1: Bland-Altman method to compare the conventional therapy and telerehabilitation on NPAD, NPRS and CV Angle

The Bland-Altman test was performed to assess the level of agreement between the conventional therapy and telerehabilitation methods regarding their impact on the Neck Pain and Disability Index scores. This analysis aimed to determine the consistency of

outcomes between the two treatment modalities for chronic neck pain management (Table 4, Figure 1).

Using the Bland-Altman method to compare the conventional therapy and telerehabilitation on the Neck Pain and Disability Index (NPAD), data from 54 participants showed a small mean bias of 1.05 (95% CI: -0.678 to 2.78), indicating no significant differences between the two methods. The limits of agreement ranged widely from -6.19 to 8.29, denoting variability yet no consistent bias in the effects on NPAD scores.

When evaluating craniovertebral angle changes, the conventional therapy resulted in a mean bias of -3.99 units (95% CI: -6.13 to -1.85) compared to telerehabilitation. This suggests a lower angle measurement with conventional therapy. The limits of agreement were from -12.96 to 4.98, implying notable variability, albeit not systemically differing between the methods.

Table 4: Bland-Altman method to compare the conventional therapy and telerehabilitation on NPAD, NPRS and CV Angle

Measures	Estimate	95% Confidence Interval	
		Lower	Upper
NPDI			
Bias (n = 20)	1.05	-0.678	2.78
Lower limit of agreement	-6.19	-9.189	-3.18
Upper limit of agreement	8.29	5.282	11.29
CVA			
Bias (n = 20)	-3.99	-6.13	-1.85
Lower limit of agreement	-12.96	-16.69	-9.24
Upper limit of agreement	4.98	1.26	8.71
NPRS			
Bias (n = 20)	-0.100	-0.400	0.200
Lower limit of agreement	-1.356	-1.877	-0.835
Upper limit of agreement	1.156	0.635	1.677

For the Numeric Pain Rating Scale (NPRS) scores, the analysis yielded a negligible mean bias of -0.100 (95%

CI: -0.400 to 0.200), with conventional therapy marginally lower than telerehabilitation. The agreement limits between the methods were relatively tight, from -1.356 to 1.156, showing that differences in pain scores were minor and both methods can be considered similarly effective for managing pain according to NPRS.

The Bland-Altman analyses suggest that while individual patient responses may vary, conventional therapy and telerehabilitation provide comparable results across NPAD, NPRS, and craniovertebral angle measures for the management of chronic neck pain, with no substantial bias favoring one method over the other.

DISCUSSION

The present study aimed to compare the effectiveness of telerehabilitation and conventional therapy interventions in managing functional disability, pain intensity, and craniovertebral angle in individuals with neck pain. The findings of this study provide valuable insights into the potential benefits and outcomes of telerehabilitation as a viable treatment option for this specific population.

The neck pain and disability are positively correlated as established by many studies. The results demonstrated that both telerehabilitation and conventional therapy interventions were effective in reducing functional disability. This finding is consistent with previous studies that have shown positive outcomes with telerehabilitation and conventional therapy in improving functional outcomes in individuals with neck pain (Cochrane Back, 2021; Ozel M, 2022). The interventions used in this study, including isometric exercises, stretching, and ergonomic modifications, likely contributed to the observed improvements in functional disability. Another research demonstrates the specific benefits of interactive telerehabilitation practices for office workers dealing with chronic nonspecific neck pain, showcasing significant improvements in pain management and functional capacity supports our study (Özlü et al., 2024). There is specific impact of spinal stabilization exercises administered via telerehabilitation on patients with chronic neck pain,

indicating marked improvements in pain relief and functional disability. This study reinforces the potential of tailored exercise programs delivered through telerehabilitation to effectively address chronic neck pain symptoms (Onan et al., 2023).

Telerehabilitation and conventional therapy interventions were effective in reducing pain intensity among individuals with neck pain. This is in line with previous research that has highlighted the analgesic effects of telerehabilitation, and conventional therapy approaches for pain management (Ozer AY; Bansal S). Supporting this notion, a research elucidates that both synchronous and asynchronous telerehabilitation methods yield comparable benefits for individuals suffering from non-specific neck pain, further affirming the versatility and effectiveness of telerehabilitation as modalities (Timurtaş et al., 2024). Additionally, one more research supports the findings as delves into the specific impacts of telerehabilitation exercises on chronic neck pain, providing a structured framework for assessing telerehabilitation's therapeutic efficacy over the conventional treatment (Antonio et al., 2024). Moreover, the clinical utility of myofeedback-based tele treatments, offering valuable insights into innovative telerehabilitation approaches tailored for non-specific neck and shoulder pain management has also been established supporting the findings of our study (Kosterink et al., 2010). It collectively underscore the broad and effective application of telerehabilitation and conventional therapy interventions in managing neck pain, highlighting their significant potential in providing pain relief and enhancing the quality of life for affected individuals.

There were significant improvements were observed in craniovertebral angle measurements after both telerehabilitation and conventional therapy interventions. These findings indicate a positive impact on postural alignment and suggest that both interventions can effectively address the postural issues associated with poor posture. Similar improvements in postural alignment have been reported in previous studies investigating therapeutic interventions for neck pain (Sahan TY, 2023 & Chua SK, 2021). There are benefits of combining exercise and

education via telerehabilitation for patients with chronic neck pain. The findings by (Özden et al., 2023) contributes valuable insights into how such a combined approach can yield positive outcomes in terms of postural correction and pain management. Furthermore, the investigation conducted by (ŞAHAN et al.)2023 explores the impact of postural-based telerehabilitation on various factors including pain, posture, energy consumption, and performance in individuals with mechanical neck pain. This study underscores the comprehensive benefits of telerehabilitation focused on postural correction supporting the findings of our study. Additionally, the findings by (Golebowicz et al., 2015) supports the effectiveness of telerehabilitation, particularly highlighting the use of biofeedback in improving postural issues among individuals who spend extended periods at computers. This research sheds light on the potential of telerehabilitation to offer practical solutions for common postural challenges faced by today's workforce.

These references collectively affirm the significant role of both telerehabilitation and conventional therapy interventions in improving postural alignment, offering compelling evidence of their effectiveness in addressing the postural issues associated with poor posture. The inclusion of these studies provides a robust foundation for understanding the multifaceted approaches to managing neck pain and postural correction through both physical and educational interventions.

The results of this study have important clinical implications. Telerehabilitation offers a convenient and accessible treatment option, particularly for individuals who face barriers in accessing in-person therapy. This mode of intervention delivery allows patients to receive care remotely, overcoming geographical constraints and reducing the need for travel to healthcare facilities (Anton D, 2018; Schmeler MR, 2009). Moreover, the positive outcomes observed with telerehabilitation interventions support its integration into clinical practice and broaden the range of treatment options available for individuals with neck pain caused by poor posture.

While this study provides valuable insights into the effectiveness of telerehabilitation and conventional therapy interventions, there are some limitations to consider. The study design, including the pre and post experimental design and convenient sampling, may limit the generalizability of the findings. Additionally, the relatively short-term follow-up period may not capture the long-term effects of the interventions.

In conclusion, this study's findings offer a comprehensive understanding of the effectiveness of both conventional therapy and telerehabilitation in managing chronic neck pain, demonstrating substantial benefits across various indicators. The results indicate significant improvements in functional disability, pain intensity, and postural adjustments, showcasing the efficacy of each treatment approach in enhancing the daily functioning and alleviating the discomfort associated with chronic neck pain. Particularly noteworthy is the potential of telerehabilitation, which, in addition to matching the outcomes of conventional therapy, emphasizes its crucial role in providing accessible, effective care. This is especially significant in today's digital age, where the demand for remote healthcare solutions is ever-increasing, highlighting telerehabilitation's importance in bridging the gap to ensure continuous, quality care for those in need. The enhancements in pain management and postural alignment across both treatment modalities underscore the value of integrating telerehabilitation into broader therapeutic strategies, affirming its vital contribution to advancing care for individuals battling chronic neck pain.

It is important to note that further research is warranted to explore the long-term effects and compare the effectiveness of these interventions in larger and more diverse populations. Additionally, considering individual patient characteristics and preferences is crucial when determining the most suitable treatment approach for optimizing outcomes in clinical practice.

Limitation of Study

The present study had few limitations that should be taken into consideration when interpreting the findings. Firstly, the sample size was relatively small, which may restrict the generalizability of the results. A larger sample would provide a more representative population and enhance the statistical power of the analysis. Secondly, the absence of a control group limits the ability to attribute the observed changes solely to the conventional therapy and telerehabilitation interventions. Including a control group, such as a group receiving no treatment or a placebo, would provide a baseline for comparison and help establish the specific effects of the interventions. Thirdly, the study may have had a limited duration of follow-up, preventing a comprehensive assessment of the long-term effects of the interventions. A longer follow-up period would allow for a better understanding of the durability of the observed improvements and the potential for any regression to the pre-treatment state.

REFERENCE

- Anton D, Berges I, Bermúdez J, Goñi A, Illarramendi A. A telerehabilitation system for the selection, evaluation, and remote management of therapies. *Sensors*. 2018 May 8;18(5):1459.
- Antonio, G. L. N., Almeida, M. Q., Vera, M. A. A., de Noronha, M. A., & Selistre, L. F. A. (2024). Efficacy of telerehabilitation exercise in patients with chronic neck pain: a protocol for a randomized controlled trial. *Brazilian Journal of Physical Therapy*, 28, 100748.
- Bansal S, Anand B, Gupta M, Solanki I. Effectiveness of Exercises by Telerehabilitation for Neck, and Shoulder Rehabilitation: A Scoping Review.
- Bansode, A., & Hande, D. (2016). Effectiveness of isometric neck exercises, stretching and ergonomics over ergonomic alone for neck pain in physiotherapists. *Imperial Journal of interdisciplinary research*, 2, 36-40.

- Bharal, S., Rizvi, M. R., AlQahtani, M. M., Alajam, R. A., Sharma, A., Ahmad, I., ... & Shawky, G. M. (2023). Effectiveness of neck stabilization and Contrology training in comparison to conventional therapy amongst individuals with Text Neck Syndrome. *European Review for Medical & Pharmacological Sciences*, 27(18).
- Borisut, S., Vongsirinavarat, M., Vachalathiti, R., & Sakulsriprasert, P. (2013). Effects of strength and endurance training of superficial and deep neck muscles on muscle activities and pain levels of females with chronic neck pain. *Journal of physical therapy science*, 25(9), 1157-1162.
- Brennan, D., Tindall, L., Theodoros, D., Brown, J., Campbell, M., Christiana, D., Smith, D., Cason, J., & Lee, A. (2010). A blueprint for telerehabilitation guidelines. *International journal of telerehabilitation*, 2(2), 31–34.
- Cheng, C. H., Su, H. T., Yen, L. W., Liu, W. Y., & Cheng, H. Y. K. (2015). Long-term effects of therapeutic exercise on nonspecific chronic neck pain: a literature review. *Journal of physical therapy science*, 27(4), 1271-1276.
- Chiu, T. T. W., & Lo, S. K. (2002). Evaluation of cervical range of motion and isometric neck muscle strength: reliability and validity. *Clinical rehabilitation*, 16(8), 851-858.
- Chua SK, Muthalib NF, Shukri M, Sharina N, Zahari Z. Effects of Home Exercise Program on Pain and Neck Functions in Individuals with Non-Specific Neck Pain. *Malaysian Journal of Medicine & Health Sciences*. 2021 Jun 2;17(3).
- Chung, S., & Jeong, Y. G. (2018). Effects of the craniocervical flexion and isometric neck exercise compared in patients with chronic neck pain: A randomized controlled trial. *Physiotherapy theory and practice*, 34(12), 916-925.
- Cochrane Back and Neck Group, Fandim JV, Costa LO, Yamato TP, Almeida L, Maher CG, Dear B, Kamper SJ, Saragiotto BT. Telerehabilitation for neck pain. *Cochrane Database of Systematic Reviews*. 1996 Sep 1;2021(3).
- Domenech, M. A., Sizer, P. S., Dedrick, G. S., McGalliard, M. K., & Brismee, J. M. (2011). The deep neck flexor endurance test: normative data scores in healthy adults. *PM&R*, 3(2), 105-110.
- Falla, D., Jull, G., & Hodges, P. (2008). Training the cervical muscles with prescribed motor tasks does not change muscle activation during a functional activity. *Manual therapy*, 13(6), 507-512.
- Falla, D., Jull, G., & Hodges, P. W. (2004). Feedforward activity of the cervical flexor muscles during voluntary arm movements is delayed in chronic neck pain. *Experimental brain research*, 157, 43-48.
- Falla, D., Jull, G., Hodges, P., & Vicenzino, B. (2006). An endurance-strength training regime is effective in reducing myoelectric manifestations of cervical flexor muscle fatigue in females with chronic neck pain. *Clinical Neurophysiology*, 117(4), 828-837.
- Falla, D., Jull, G., Russell, T., Vicenzino, B., & Hodges, P. (2007). Effect of neck exercise on sitting posture in patients with chronic neck pain. *Physical therapy*, 87(4), 408-417.
- Falla, D., Rainoldi, A., Merletti, R., & Jull, G. (2003). Myoelectric manifestations of sternocleidomastoid and anterior scalene muscle fatigue in chronic neck pain patients. *Clinical neurophysiology*, 114(3), 488-495.
- Golebowicz, M., Levanon, Y., Palti, R., & Ratzon, N. Z. (2015). Efficacy of a telerehabilitation intervention programme using biofeedback among computer operators. *Ergonomics*, 58(5), 791-802.
- Jorritsma, W., Dijkstra, P. U., de Vries, G. E., Geertzen, J. H., & Reneman, M. F. (2012). Detecting relevant changes and responsiveness of neck pain and disability scale and neck disability index. *European Spine Journal*, 21, 2550-2557.
- Jull, G. A., Falla, D., Vicenzino, B., & Hodges, P. W. (2009). The effect of therapeutic exercise on activation of the deep cervical flexor muscles in people with chronic neck pain. *Manual therapy*, 14(6), 696-701.

- Jull, G. A., Falla, D., Vicenzino, B., & Hodges, P. W. (2009). The effect of therapeutic exercise on activation of the deep cervical flexor muscles in people with chronic neck pain. *Manual therapy*, 14(6), 696-701.
- Jull, G., & Falla, D. (2016). Does increased superficial neck flexor activity in the craniocervical flexion test reflect reduced deep flexor activity in people with neck pain? *Manual therapy*, 25, 43-47.
- Jull, G., Trott, P., Potter, H., Zito, G., Niere, K., Shirley, D., ... & Richardson, C. (2002). A randomized controlled trial of exercise and manipulative therapy for cervicogenic headache.
- Kosterink, S. M., Huis in't Veld, R. M., Cagnie, B., Hasenbring, M., & Vollenbroek-Hutten, M. M. (2010). The clinical effectiveness of a myofeedback-based telerehabilitation service in patients with non-specific neck and shoulder pain: a randomized controlled trial. *Journal of Telemedicine and Telecare*, 16(6), 316-321.
- Levy, C. E., Geiss, M., & David Omura DPT, M. H. A. (2015). Effects of physical therapy delivery via home video telerehabilitation on functional and health-related quality of life outcomes. *Journal of Rehabilitation Research and Development*, 52(3), 361.
- Mayoux-Benhamou, M. A., Revel, M., Vallee, C., Roudier, R., Barbet, J. P., & Bargy, F. (1994). Longus colli has a postural function on cervical curvature. *Surgical and radiologic anatomy: SRA*, 16(4), 367-371.
- Onan, D., Ulger, O., & Martelletti, P. (2023). Effects of spinal stabilization exercises delivered using telerehabilitation on outcomes in patients with chronic neck pain: a randomized controlled trial. *Expert Review of Neurotherapeutics*, 23(3), 269-280.
- Özden, F., Özkeskin, M., Tümtürk, İ., & Kılınç, C. Y. (2023). The effect of exercise and education combination via telerehabilitation in patients with chronic neck pain: A randomized controlled trial. *International Journal of Medical Informatics*, 180, 105281.
- Özel M, Kaya Ciddi P. The effectiveness of telerehabilitation-based structured exercise therapy for chronic nonspecific neck pain: A randomized controlled trial. *Journal of Telemedicine and Telecare*. 2022 May 16:1357633X221095782.
- Ozer AY, Kapsigay B, Şenocak E, Karaca S, Tanhan A, Elma H, Ergen Ö, Polat MG. Effectiveness of different exercise programs in individuals with non-specific neck pain: telerehabilitation, given with synchronous exercises versus homebased exercise. *Medicina Sportiva: Journal of Romanian Sports Medicine Society*. 2021 Apr 1;17(2):3327-35.
- Özlü, A., Ünver, G., Tuna, H. İ., & Erdoğan, A. (2024). Effects of interactive telerehabilitation practices in office workers with chronic nonspecific neck pain: Randomized controlled study. *Telemedicine and e-Health*, 30(2), 438-447.
- Patroncini, M. (2011). The Effect of Therapeutic Exercise on Activation of the Deep Cervical Flexor Muscles in People with Chronic Neck Pain. *manuelletherapie*, 15(01), 46-47.
- Şahan Ty, Türker D, Aksu Bn, Özcan M, Yavaş E, Uluşahin SB. Effects of The Postural Based Telerehabilitation on Pain, Posture, Energy Consumption and Performance in Mechanic Neck Pain: A Crosssectional Study-12-Week Trial. *International Journal of Disabilities Sports and Health Sciences*.;6(2):150-60.
- Schmeler MR, Schein RM, McCue M, Betz K. Telerehabilitation clinical and vocational applications for assistive technology: research, opportunities, and challenges. *International Journal of Telerehabilitation*. 2009;1(1):59.
- Timurtaş, E., Selçuk, H., Uğur Canöz, E., Inceer, M., Batar, S., Demirbüken, İ., & Polat, M. G. (2024). Synchronous and asynchronous telerehabilitation methods produce similar benefits in individuals with non-specific neck pain. *Archives of Orthopaedic and Trauma Surgery*, 144(2), 559-566.
- Ylinen, J., Kautiainen, H., Wirén, K., & Häkkinen, A. (2007). Stretching exercises vs manual therapy in treatment of chronic neck pain: a randomized, controlled cross-over trial. *Journal of rehabilitation medicine*, 39(2), 126-132.