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Effectiveness of Deep Cervical Fascial Manipulation® and Yoga Postures on Pain and Function in Patients with Mechanical Neck Pain: A Pragmatic, Parallel-Group, Randomised, Controlled Trial

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Abstract: Background: This study aimed to investigate the effect of fascial manipulation (FM) of the deep cervical fascia (DCF) and sequential yoga poses (SYP) on pain and function in individuals with mechanical neck pain (MNP). Method: Following the predefined criteria, ninety-nine individuals with MNP were recruited, randomised and assigned to either the intervention group (IG) (n=51) or the control group (CG) (n=48). Individuals in the IG received FM (4 sessions in 4 weeks) along with the home-based SYP (4 weeks). The CG participants received the usual care (cervical mobilization and thoracic manipulation (4 sessions in 4 weeks) along with unsupervised therapeutic exercises (4 weeks). The participants underwent baseline and weekly follow-up measurements of pain using a numerical pain rating scale (NPRS) and elbow extension range of motion (EEROM) during upper limb neurodynamic test 1 (ULNT1). The baseline and the 4th session follow-up measurements of the Patient-specific Functional Scale (PSFS) and Fear-avoidance Behavior Questionnaire (FABQ) were also taken. Results: A repeated-measures ANOVA was performed. The mean differences between the IG and CG on NPRS 3rd and 4th sessions are -1.009 ($p< 0.05$) and -1.701 ($p< 0.001$), respectively; on EEROM in the 4th session is 20.120 ($p< 0.001$); on FABQ during the follow-up is -5.036 ($p<0.001$), showing a statistically significant difference, whereas on PSFS during follow-up is 0.263 ($p=0.566$), suggesting no significant differences in PSFS. Conclusion: FM and SYP can aid in reducing pain and fear avoidance behavior as well as improving the function and extensibility of the upper quarter region.

Keywords: cervical pain; musculoskeletal manipulation; stretching; soft tissue mobilisation

1. Introduction:

A common musculoskeletal condition in adults, mechanical neck pain (MNP), is characterised by nonspecific discomfort at the cervicothoracic junction that may or may not radiate to the upper extremity (UE) [1–3]. The possibility of persistent symptoms in nearly half of MNP patients greatly increases overall disability and places a tremendous burden on society [1,3]. A study looking at the causes of upper quadrant pain revealed that adults' neck pain increased with prolonged computer and mobile device use without physical activity [4].

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MNP and its associated symptoms are commonly treated conservatively with electrical modalities, manual therapy, and exercise [3,5]. According to a systematic review, cervical mobilization and manipulation have comparable benefits on pain, function, and patient satisfaction. A review has reported that several cervical manipulations over time may reduce pain and improve function compared with drugs and has also shown that cervical mobilisation (CM) is equally effective as manipulation [6]. Given the correlation between reduced thoracic spine mobility and neck pain as well as the increased risk of cervical manipulation, thoracic manipulation (TM) and CM were preferred in the usual care group in this study [7]. In addition, it has not been sufficiently shown through research whether therapeutic exercises (TEs) are beneficial for those with neck discomfort [8]. Although the plausible cause of cervicobrachial pain is mechanosensitive neural tissue, a study stated that only 19.9% of cases are neurogenic and implied that not all "positive tension tests" indicate negative neurodynamics [9,10].

According to studies, there are myofascial expansions (ME) where the deep fascia (DF) joins the various muscles of the upper quarter region (UQR), which may result in cervicobrachial discomfort and nociceptive pain [11]. The upper extremities, neck and head are interconnected by the ME of the deep lamina of the deep cervical fascia (DCF), thus forming the myofascial continuum (MC) of the UQR [12]. The proprioceptors have the potential to develop into nociceptors, converting mechanical inputs into pain signals [12]. Also, an alteration in the hyaluronan's viscosity leads to adhesions resulting in altered activation of the mechanoreceptors inducing pain [13–16]. Thus, dysfunctions of DCF may be a plausible causative factor of nonspecific pain in the UQR associated with MNP. The restricted movement of collagen and elastin fibres due to the increased viscosity of the ground substance is restored by fascial manipulation (FM). The flexibility of myofascial structures may be increased by manipulating the points at the densified centre of coordination (CC) and centre of fusion (CF), which would improve fascial mobility and reduce symptoms [17,18]. Sequential yoga poses (SYP) restore fluid flow and improve the effectiveness and efficiency of the muscles by reducing the thixotropy of the ground substances [19–21]. The patient-specific functional scale (PSFS) and the numeric pain rating scale (NPRS), respectively, were employed in this study to evaluate function and pain [22].

The management of MNP normally demands an extensive course of treatment without a discernible benefit. Concomitant symptoms of the upper quarter region may develop as a result of the DCF's anatomical MC being impaired. This mandates a carefully planned study that makes use of DCF manipulation in MNP. Thus, this study intended to compare the effectiveness of FM of DCF and SYP to the usual care, which included home-based therapeutic exercises (TE), thoracic manipulation (TM), cervicothoracic manipulation (CTM), and cervical mobilization (CM), in patients with subacute and chronic MNP.

2. Materials and Methods:

2.1.

A total of 125 participants aged 18-45 years with subacute or chronic MNP for three weeks or more were screened. Patients with inflammatory conditions, skin infections, bony lesions, vestibular balance issues, sensory or motor deficiencies of the upper quadrant, UQR surgical/traumatic history within the past year were excluded from the study. The Institutional Research (IRC) and Ethics Committees (IEC) of Kasturba Medical College (KMC) and Kasturba Hospital (KH) (ECR/146/Inst/KA/2013/RR-19), MAHE, Manipal, Karnataka, India, gave their approval for the study. The trial was registered on January 24, 2020, at ClinicalTrials.gov (CTRI/2020/01/022934), with approval ID 790/2019 IEC.

2.2. Study design:

Two parallel groups were used in this pragmatic, outcome assessor-blinded, randomised controlled trial. Ninety-nine participants were recruited for this study. The flow of the study is illustrated in Figure 1.

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2.3. Interventions:

CM, TM, CTM and TE were delivered to the patients in the usual care group (UCG), whereas the participants in the intervention group (IG) received FM. Both groups received treatment during day one and the subsequent three treatment sessions with a minimum of 4 days between the sessions. The instructions pertaining to the home-based TE for the UCG and SYP for the IG were provided during the first treatment session and were monitored during the subsequent treatment sessions.

Usual care group (CM, CTM, TM and TE)

Mobilization includes oscillatory movements with a larger amplitude (for treating pain) and a smaller amplitude movement at the end of the range (for treating stiffness). For the treatment of muscle spasm, a sustained position was maintained at a point where movement was restricted by muscle spasm and was interspersed with oscillatory mobilisation. Manipulation (unidirectional thrust movement) includes cervicothoracic and upper thoracic manipulation (rotation gliding C7–T3) and thoracic manipulation (rotation gliding T4–T9) [23–27].

Therapeutic exercises (TE):

TE includes flexibility, craniocervical flexion (CCF) re-education, deep neck flexor/extensor and axio-scapular muscle training [3,8].

Intervention group (FM and SYP)

The intervention group received fascial manipulation® (FM) and sequential yoga poses (SYP).

Fascial Manipulation®:

Fascial manipulation® (FM) includes locating the densified points, also known as the centre of coordination (CC) and centre of fusion (CF), on the deep fascia and applying manipulation (deep friction massage) for 5-8 minutes at each densified point using knuckles or elbows [16,17,27]. High reliability was shown for the validity of movement as well as palpation verifications in coxarthrosis patients using the FM approach, even when carried out by inexperienced FM practitioners [27]. The exact locations of the CC and CF points and the treatment procedures are depicted in detail in the study protocol [28].

Sequential yoga poses:

The details of the sequences of SYP and the methods of postures are clearly illustrated in the study protocol [28]. Each posture was initially held for five breath cycles and progressed by increasing the number of breath cycles [20,28].

Intervention adherence:

The effectiveness of rehabilitation exercises is increased by strict adherence to them. Few authors have reported that back pain patients may obtain better benefits from strong exercise adherence [29,30]. The significance of the proper execution of TE and SYP was emphasised to the patients.

2.4. Outcomes

Primary outcome measure

- Numeric pain rating scale (NPRS).

Secondary outcome measures

- Patient-specific functional scale (PSFS)
- Fear-avoidance belief questionnaire – physical activity (FABQ-PA)
- Elbow extension range of motion during upper limb neurodynamics test 1 (ULNT1).

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Numeric Pain Rating Scale:

The NPRS is a valid and reliable scale used for MNP patients with moderate reliability (ICC = 0.67; [0.27 to 0.84]) [22]. A reduction of 2 points in the NPRS is usually regarded as the minimal clinically important difference (MCID) in patients with chronic musculoskeletal pain [31]. NPRS values were collected during baseline and before the 2nd, 3rd, and 4th treatment sessions. Principal analysis was performed for changes in the mean between the groups from baseline to the 2nd, 3rd, and 4th treatment sessions.

Patient-Specific Functional Scale:

In the PSFS, patients' three most difficult activity limitations are quantified. The overall score is calculated by dividing the total number of activities by the sum of all activity scores. The minimum detectable change (MDC) is 2 points for average ratings and 3 points for single activity scores [32]. The data are shown as the mean difference between groups. Analysis was conducted to identify changes between the baseline and the last treatment session as well as between the groups.

Fear Avoidance Beliefs Questionnaire- physical activity (FABQ-PA)

The fear-avoidance beliefs questionnaire (FABQ-PA) examines patients' dread of pain and subsequent avoidance of physical activity as a consequence of that fear [33]. More significant fear-avoidance beliefs are indicated by FABQ-PA scores above 15 [34]. FABQ-PA results contain a total score, and when it is 15 or higher, it can be regarded as elevated. Lee et al. have demonstrated that the FABQ-PA questionnaire is reliable with an ICC value of 0.81 and a Cronbach's alpha coefficient of 0.90 [35]. Principal analyses were performed to determine changes between the baseline and during the final treatment session and the results are presented as the mean difference between groups.

Elbow extension ROM during the upper limb neurodynamic test:

The elbow extension ROM (EEROM) is the region of the elbow range during ULNT1, where the patient feels discomfort measured with a universal goniometer [36]. The EEROM during ULNT1 correlates with the instant of submaximal pain in neck pain that can be quantified with accuracy in clinical setting [37]. The analysis was performed for changes from baseline to every treatment session and between the groups.

2.5. Recruitment, allocation, and implementation:

The patients underwent physical and radiographic assessments by the orthopedician. Patients with MNPs who had any alarming signs for manual therapy were excluded. Participants were randomly assigned to either the control group or the intervention group using a 1:1 allocation ratio. The sequence was computer-generated using the www.randomiser.org website. Sixteen blocks of 10 people (5 in the CG and 5 in the IG) were used. Using sequentially numbered, sealed, opaque envelopes, the participants were divided into groups. The participants who fulfilled the inclusion criteria and consented to participate in the trial were randomised. The outcome assessor was blinded, and the same outcome assessors performed all post allocation assessments.

2.6. Statistical methods:

Repeated measures ANOVA was used for all continuous primary and secondary outcomes. All statistical tests were carried out at a 5% (two-sided) significance level using the IBM Statistical Package for Social Sciences (IBM SPSS Statistics for Windows, Armonk, NY, USA: IBM Corp). The mean scores are reported for all the outcomes measured between different time points of measurement. The differences in all outcomes between the interventional and control groups are reported. Regardless of the protocol's adherence, all significant analyses—including all individuals who were randomly assigned—were carried out as intention-to-treat (ITT) analyses.

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3. Results

3.1. Patient Characteristics:

Three patients from the IG and three patients from the UCG withdrew during the follow-up period; as a result, 48 patients in the CG and 45 patients in the UCG completed the study, as shown in Figure 1. The participant's demographic characteristics are shown in Table 1.

Table 1. Participants' demographic characteristics.

Characteristics	Group		Mean ±SD
Age	CG	N =48	26.1±5.83
	IG	N=51	27.8±8.00
Gender: n (%)	CG	Male	27 (27.3)
		Female	21 (21.2)
	IG	Male	23 (23.2)
		Female	28 (28.3)

N – Number of participants, FM-Fascial manipulation, SYP-Sequential yoga poses, CM-Cervical mobilisation, TM-Thoracic manipulation, CTM-Cervicothoracic manipulation, TE-Therapeutic exercises, SD-standard deviation.

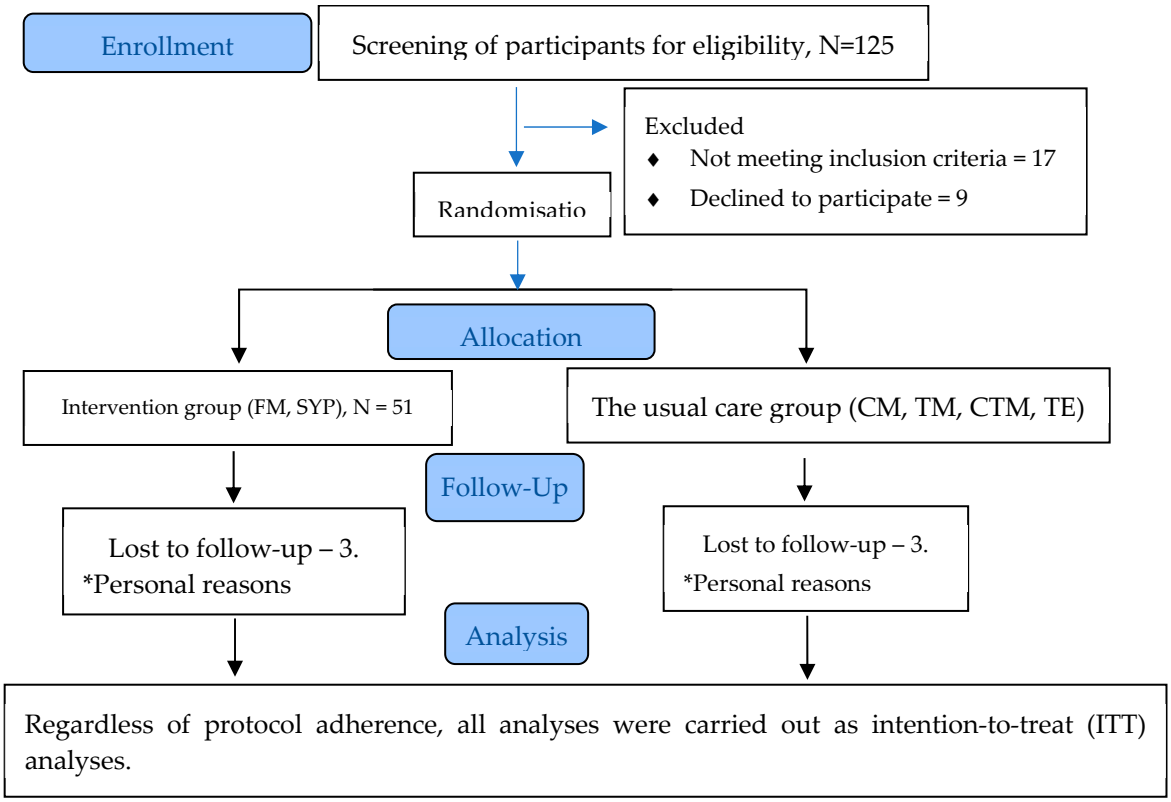

Figure 1. CONSORT diagram of the study design. * Indicating the reasons for withdrawal. FM-Fascial manipulation, SYP-Sequential yoga poses, CM-Cervical mobilisation, TM- Thoracic manipulation, *CTM-Cervicothoracic manipulation, TE-Therapeutic exercise, CG – Control group, IG – Intervention group. * Indicating the reasons for withdrawal.*

3.2.

A repeated-measures ANOVA was performed to determine the effect of the IG (FM and SYP) compared to the CG (CM, TM, CTM and TE) on NPRS and EEROM (over four measurement time points) and FABQ-PA and PSFS (over two measurement time points). The means and the standard deviations for all the dependent variables are reported in Table 2.

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Table 2. Mean values of outcomes during different time points of measurement.

Timeline	Group	NPRS (Mean ± SD)	EEROM (Mean ± SD)	FABQ (Mean ± SD)	PSFS (Mean ± SD)
Baseline	CG	5.93±1.572	131.60± 35.70	14.02± 5.187	4.52± 1.592
	IG	6.29±1.969	112.92±57.960	11.27±7.274	3.71±1.958
2nd session	CG	4.64±1.417	139.02±31.484		
	IG	4.31±1.557	130.04±43.561		
3rd session	CG	4.11±1.799	141.02±30.881		
	IG	3.10±1.896	146.61±32.495		
4th session	CG	3.33±1.871	143.78±31.947	11.75±4.352	6.23±1.696
	IG	1.63±1.482	163.90±21.045	6.71± 6.334	6.49 ± 2.559

NPRS-Numerical Pain Rating Scale, EEROM-Elbow Extension Range of Motion, FABQ-Fear Avoidance Behaviour Questionnaire, PSFS -Patient Specific Functional Scale, CG-Control group, IG-Intervention group.

3.2.1. NPRS

The Wilke lambda was statistically significant, Wilke lambda = 0.16, F (3, 90) = 156.98, P<0.01, partial η^2 = 0.840, indicating a change in the NPRS score across the time frame with consecutive sessions. Additionally, there was a significant difference in the NPRS score with the group interaction, Wilke Lamda = 0.699, F (3, 90) =156.98, P<0.01, partial η^2 = 0.301, indicating that the variation in the means of NPRS over repeated measurement occasions varied as a function of the group, as shown in Table 3.

Table 3. Group interaction with all outcomes at different measurement time points.

	Outcomes	F value	p-value	partial η^2
Huynh-Feldt	NPRS	270.58	<.001	.746
	NPRS*Group	22.482	<.001	.196
Greenhouse-Geisser	EEROM	53.89	<.001	.369
	EEROM*Group	21.46	<.001	.189
Huynh-Feldt	FABQ	70.02	<.001	.435
	FABQ*GROUP	7.806	.006	.079
Huynh-Feldt	PSFS	79.04	<.001	.465
	PSFS*GROUP	4.517	.036	.047

** Interaction of group with the outcome, η^2- eta squared, NPRS-Numerical Pain Rating Scale, EEROM-Elbow Extension Range of Motion, FABQ-Fear-avoidance behavior questionnaire, PSFS -Patient Specific Functional Scale, CG-Control group, IG-Intervention group.*

Mauchly's test indicated that the assumption of sphericity had been violated, χ^2 (5) = [32.483], p< 0.001; therefore, degrees of freedom were corrected using Huynh-Feldt estimates of sphericity (ε = 0.823). The within-subjects' effects on the NPRS score were statistically significant, Hyunh-Feldt F (2.469, 227.17) = 270.58, P< 0.001, partial η^2 = 0.746. Additionally, the group had a significant interaction effect on NPRS, Hyunh – Feldt F (2.469, 227.17) = 22.48, P< 0.001. Partial η^2 = 0.196 showing an interaction between the NPRS measurement occasions and the treatment groups. Additionally, the difference in the repeated measures of the NPRS over time differed between the treatment groups. The mean differences between the IG and CG in the NPRS 3rd and 4th sessions were -1.009 (p< 0.05) and -1.701 (p< 0.001), respectively, suggesting a significant reduction in pain in the IG when compared to the CG at the 3rd and 4th sessions, as depicted in Table 4.

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Table 4. Mean differences between IG and CG of all outcomes.

Timeline	NPRS				EEROM				FABQ				PSFS			
	MD	SE	p-value	η^2_p	MD	SE	p-value	η^2_p	MD	SE	p-value	η^2_p	MD	SE	p-value	η^2_p
Baseline	.352	.370	.343	.010	-18.6	10.03	.066	.036	-2.75	1.32	.04	.046	-.80	.37	.033	.049
2nd session	-.338	.308	.275	.013	-8.98	7.90	.259	.014								
3rd session	-1.00	.382	.010	.070	5.59	6.55	.396	.008								
4th session	-1.70	.347	<.001	.207	20.12	5.53	<.001	.126	-5.03	1.14	<.001	.17	.26	.45	.566	0.04

η^2_p- partial eta squared MD-Mean difference, SE-Standard error, NPRS-Numerical Pain Rating Scale, EEROM-Elbow Extension Range of Motion, FABQ-Fear. Avoidance behavior Questionnaire, PSFS -Patient Specific Functional Scale, CG-Control group, IG-Intervention group.

3.2.2. EEROM

The Wilke lambda was statistically significant, Wilke lambda = 0.58, F (3, 90) = 21.697, P<0.001, partial η^2 = 0.420, indicating a change in the EEROM across the sessions. Additionally, there was a significant difference in the EEROM with the group interaction, Wilke Lamda = 0.744, F (3, 90) =10.33, P<0.01, partial η^2 = 0.256, indicating that the variation in the EEROM means during the subsequent measurements varied as a function of the group, as shown in Table 3.

Mauchly's test (P< 0.001) implied that the sphericity assumption was not met, whereas the Greenhouse–Geisser Epsilon value was 0.491, suggesting the use of Greenhouse–Geisser adjustment. The within-subjects effects on EEROM were statistically significant, Greenhouse–Geisser, F (1.472, 135.439) = 53.897, P< 0.001, partial η^2 = 0.369. Additionally, there was a significant treatment group interaction effect on EEROM, Greenhouse–Geisser F (1.472, 135.439) = 21.46, P< 0.001, partial η^2 = 0.189. These results showed an interaction between the EEROM measurement occasions and the treatment groups. Additionally, the differences in the repeated measures of EEROM over the subsequent sessions differed across the treatment groups. These results are presented in Table 3.

The Bonferroni-adjusted pairwise comparison of each group's average EEROM between the sessions within subjects indicates a difference that is statistically significant (p<0.001). There were no statistically significant differences between the IG and CG between the baseline and first 3 sessions. The mean difference between the IG and CG in EEROM in the 4th session was 20.120 (p< 0.001), suggesting a considerable improvement in EEROM in the IG compared to the CG from baseline to the 4th session, as shown in Table 4.

3.2.3. FABQ-PA

The Wilke lambda is statistically significant, Wilke lambda = 0.565, F (1, 91) =70.023, P<0.01, partial η^2 = 0.435, indicating a change in the FABQ-PA in the 4th session compared to the baseline. Additionally, there is a significant difference in the FABQ-PA score with the group interaction, Wilke Lamda = 0.921, F (1, 91) =7.806, P=0.06, partial η^2 = 0.079, indicating that the variation in the means of FABQ-PA measurements on different occasions varies as a function of the group. Mauchly's test of sphericity (P< 0.001) indicated that the assumption of sphericity was not met, whereas the Greenhouse–Geisser Epsilon value was > 0.75, suggesting the use of Huynh-Feldt adjustment. The within-subject effects on FABQ-PA were statistically significant, Huynh-Feldt F (1, 91) = 70.023, P< 0.001. Additionally, there was a significant difference in the between-group interaction effect, Huynh-Feldt F (1, 91) = 7.806, P=0.006. These results, as reported in Table 3, demonstrated an interaction between the FABQ-PA measurement occasions and the treatment groups. Additionally, the differences in the measurement of EEROM from baseline to follow-up differed across the treatment groups. The mean difference between the IG and CG of the FABQ-PA during the follow-up was -5.036 (p<0.001), indicating a difference that is statistically significant in the FABQ-PA during the follow-up compared to the baseline score and is reported in Table 4.

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3.2.4. PSFS

The Wilke lambda was statistically significant, Wilke lambda = 0.535, F (1, 91) =79.023, P<0.01, indicating a change in the PSFS from baseline to follow-up. Additionally, there is a significant difference in the PSFS with the group interaction, Wilke Lamda = 0.953, F (1, 91) =4.517, P=0.36, indicating that the variation in the means of PSFS measurement during the follow-up varies as a function of the group.

Mauchly's test (P< 0.001) indicated that the sphericity assumption was not met. The Greenhouse–Geisser Epsilon value is > 0.75, suggesting the use of Huynh--Feldt adjustment with the univariate test of the mean difference. The within-subject effects on PSFS are statistically significant, Huynh-Feldt F (1, 91) = 79.043, P< 0.001. Additionally, there was a substantial difference in the between-group interaction effect, Huynh-Feldt F (1, 91) = 4.517, P< 0. 001, as indicated in Table 3.

The Bonferroni-adjusted pairwise comparison of each group's average PSFS scores (averaged across the sessions) was not statistically significant, p= 0.412. The mean difference in PSFS between the IG and CG during follow-up was 0.263 (p=0.566), suggesting no statistically significant difference in the PSFS value in the IG compared to the CG, as specified in Table 4. The comparison of effects between the CG and IG on all the outcomes at different timepoints of measurement is shown in Figure 2

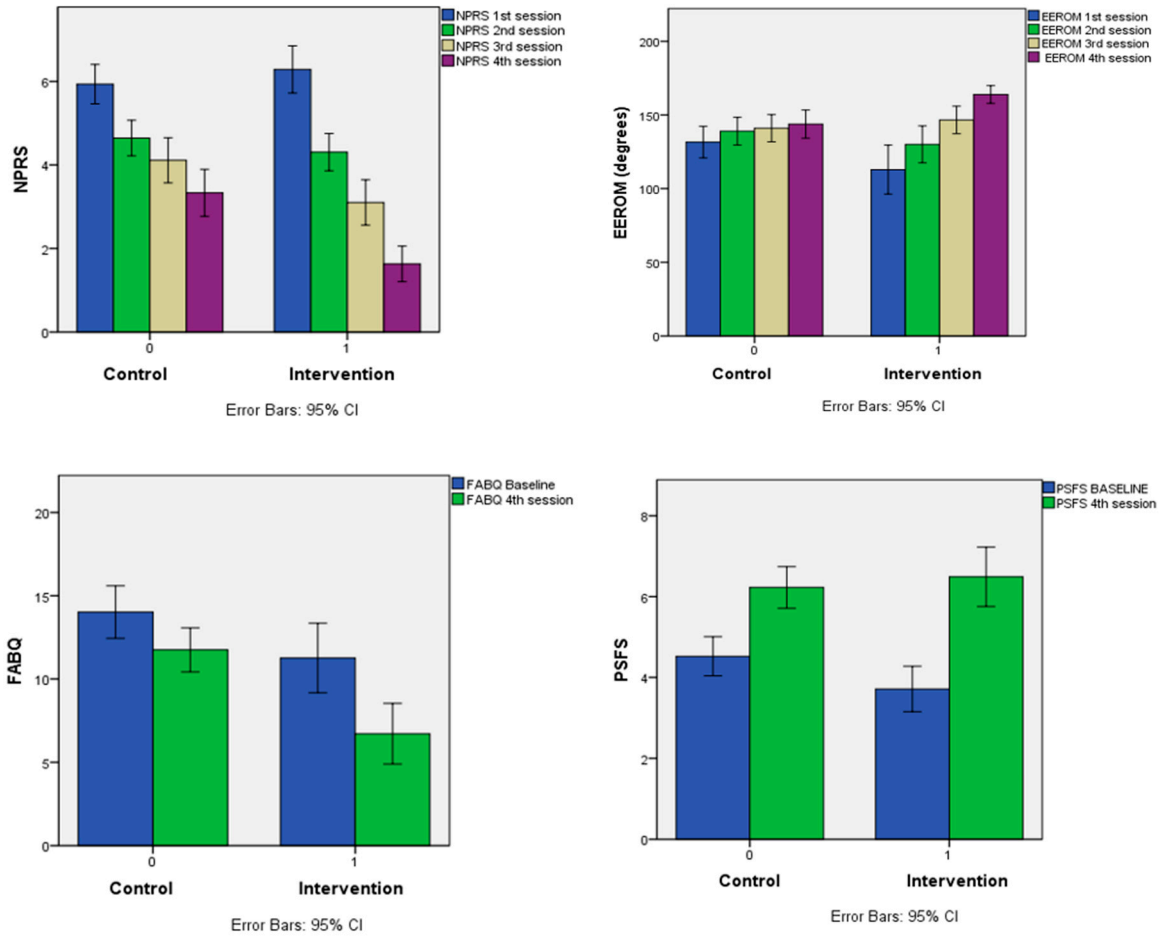

Figure 2. Comparison between the CG and IG effects on the outcomes at different measurement time points. *NPRS-Numerical Pain Rating Scale, EEROM-Elbow Extension Range of Motion, FABQ-Fear Avoidance Behavior Questionnaire, PSFS -Patient Specific Functional Scale, CG-Control group, IG-Intervention group.*

4. Discussion

The results indicate that there is a reduction in pain and fear avoidance beliefs (FAB), as well as improvement in function and EEROM, during the subsequent treatment sessions in both the IG (FM and SYP) and CG (CM, TM, CTM and TE). The results demonstrated that there was a significant reduction in pain (third & fourth sessions) and FAB as well as improvement in function and EEROM (fourth session) in the IG compared to the CG.

The reduction in pain as measured by the NPRS was statistically significant. The minimal clinically important difference (MCID) for chronic persistent musculoskeletal pain is considered to be 2 (i.e., patients are usually considered improved when there is a reduction in NPRS by 2) [31]. Few authors have reported that the cut-off values for the change in NPRS for the moderate (4–6), severe pain (7–10), and moderate plus severe pain (4–10) groups were 1.3, 1.8, and 1.5, respectively, based on the pretreatment pain score. Therefore, it was suggested that, for practical purposes, MCID values for change in the NPRS scale can be rounded up to 1 regardless of the degree of pain severity prior to the treatment [38]. Given this, there was a noticeable decrease in pain in the third and fourth sessions in the IG compared to the CG. Considering the partial eta squared (η^2_p) values of 0.07 (third session) and 0.207 (final session), there were moderate and large effect sizes in the 3rd and 4th sessions, respectively, between the IG and CG. This study's findings are consistent with those of a recent study, where subsequent therapy sessions saw a significant reduction in pain using standard FM, whereas there was a substantial pain reduction in the 3rd session and 1-month follow-up while using the modified FM method. [39].

The EEROM during the ULNT1 data indicated that there was a substantial improvement in the EEROM in all subsequent sessions compared to the previous sessions in both the intervention and control groups. Few studies have reported that an improvement of approximately 7·5° in EEROM can be considered the minimal important difference [36,37] In this study, the mean difference between the IG and CG in EEROM in the 4th session was 20°, suggesting a considerable improvement in EEROM in the IG compared to the CG from baseline to the 4th session. Additionally, the η2p value of 0.126 in the last session showed a larger effect size in the EEROM during ULNT1 when the IG was compared with the CG. Costello M et al reported greater immediate improvements in EEROM during ULNT1 following soft tissue mobilisation in patients with cervicobrachial pain [36]. Patients with reduced neural extensibility in their upper limbs, as indicated by decreased EEROM during ULNT1, showed a decreased length of the upper trapezius, thus showing that restrictions in the soft tissues that surround the nerves may impair neural mobility [40]. Few authors have discussed the plausible involvement of deep fascia in fascial entrapment neuropathy which presents a difficult diagnostic problem [41]. Considering the rich innervation of the deep fascia and the presence of tender taut bands on the soft tissues of the UQR associated with myofascial dysfunctions, may also give nociceptive input to the nervous system, thus contributing to the MNP perceived by the patient [42–44]. Thus, in this study, although the treatment in the IG targets the soft tissues of the UQR, there is a profound improvement in neural extensibility, as indicated by an increase in the EEROM during ULNT1.

The mean difference between the IG and CG on the FABQ during the follow-up was -5.036 ($p<0.001$). suggesting a statistically significant difference in FABQ scores in the IG compared to the CG. A change of 4 points on the FABQ-PA is considered MCID, which seems to accurately identify meaningful changes in fear-avoidance beliefs [45]. There was a reduction of approximately 5 points in the IG compared to the change of just 2 points in the CG. Additionally, there was a larger effect size (η^2_p= 0.17) in the IG during the 4th session compared to the baseline. Thus, the IG can be considered clinically significant in reducing the FAB compared with the CG in this study. A study that explored the effectiveness of myofascial release also demonstrated a substantial decrease in the FAB score in patients with chronic low back pain [46].

The PSFS data showed that there was a change in the PSFS value from baseline to follow-up in both the IG and CG. The mean difference in PSFS between the IG and CG during follow-up was 0.263 ($p=0.566$), suggesting no statistically significant difference. Similarly, there was a very small effect size (η^2_p= 0.04) when comparing the 4th session with the baseline between the control and intervention

groups. However, a study has reported that the minimum detectable change (MDC) for PSFS is 2 points for average ratings [32]. The mean change in the PSFS score from baseline (4.52± 1.592) to follow-up (6.23±1.696) in the CG was < 2, whereas the mean change from baseline (3.71±1.958) to follow-up (6.49 ± 2.55) in the IG was > 2, which is above the MDC, thus clinically showing that the IG may be better at improving the PSFS than the CG. The positive influence of FM in restoring function was also reported in a recent study by Kamani et al. in patients with chronic ankle instability [18].

5. Conclusions

The fascia-directed approach, such as FM and SYP, can be considered an effective tool in the effective treatment of patients with MNP, reducing pain and fear avoidance behavior as well as improving the function and extensibility of the upper quarter region. Future studies are needed in order to investigate the long-term efficacy of FMs.

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Informed Consent Statement: Before taking part in the study, each subject gave their informed consent.

Data Availability Statement: On request, the corresponding author will provide access to the data used in this work. Due to ethical constraints, the data are not publicly accessible.

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