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Research Article

The Effects of Electroacupuncture and Connective Tissue Massage on Fibromyalgia Symptoms: A Comparative Clinical Trial

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ABSTRACT

The characteristic features of fibromyalgia syndrome (FMS) are widespread musculoskeletal pain and depressive symptoms. Although electroacupuncture (EA) and connective tissue massage (CTM) have been investigated in FMS, no previous comparative study has assessed their differing effects on pain threshold, pain intensity, number of tender points, morning stiffness, depression, anxiety, shoulder range of motion and sleep quality. Therefore, we aimed to compare the efficacy of EA and CTM on these parameters.

Sixty FMS patients were randomly assigned to either the EA (EAG, n=30) or CTM (CMG, n=30) groups. EA was administered using sterile silver needles at tender and acupuncture points, accompanied by electrical stimulation, for five sessions per week, 20 minutes each, over a total of four weeks; CTM was administered with the same session frequency, duration and number of weeks. Participants were assessed twice: at baseline and immediately after the final intervention.

Significant improvements were observed in both groups regarding pain threshold, number of tender points, pain intensity, depression and sleep quality (p<0.05). EAG produced more effective results in pain threshold (p<0.001), pain intensity (p=0.001) and both right and left shoulder flexion (p=0.045 and p=0.03, respectively), while CMG was more effective for depression (p=0.005). No significant differences were found between the groups in morning stiffness, number of tender points, anxiety, shoulder abduction or sleep quality (p>0.05).

Both electroacupuncture and CTM are effective interventions for improving FMS symptoms. While EA demonstrates more effective pain modulation via endogenous opioid pathways, CTM is more effective in reducing depressive symptoms via autonomic modulation. These findings support the view that treatment selection in FMS should be individualized.

Keywords: *Pain threshold, morning stiffness, depression, sleep quality.*

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ÖZET

Arka Plan: Fibromiyalji sendromunun (FMS) karakteristik özellikleri, yaygın kas-iskelet ağrısı ve depresif semptomlardır. FMS'de elektroakupunktur (EA) ve bağ dokusu masajı (BDM) araştırılmış olmasına rağmen, bunların ağrı eşiği, ağrı şiddeti, hassas nokta sayısı, sabah tutukluğu, depresyon, anksiyete, omuz eklem hareket açıklığı ve uyku kalitesi üzerindeki farklı etkilerini değerlendiren daha önce yapılmış karşılaştırmalı bir çalışma bulunmamaktadır. Bu nedenle, EA ve BDM'nin bu parametreler üzerindeki etkinliğini karşılaştırmayı amaçladık.

Yöntemler: Atmış FMS hastası rastgele EA (EAG, n=30) veya BDM (BDMG, n=30) gruplarına ayrıldı. EA; hassas ve akupunktur noktalarına steril gümüş iğneler kullanılarak, elektriksel stimülasyon eşliğinde, toplam dört hafta boyunca haftada beş seans ve her seans 20 dakika olacak şekilde uygulandı; BDM de aynı seans sıklığı, süresi ve hafta sayısıyla uygulandı. Katılımcılar iki kez değerlendirildi: başlangıçta ve son müdahaleden hemen sonra.

Bulgular: Her iki grupta da ağrı eşiği, hassas nokta sayısı, ağrı şiddeti, depresyon ve uyku kalitesinde anlamlı iyileşmeler gözlendi ($p<0.05$). EAG; ağrı eşiği ($p<0.001$), ağrı şiddeti ($p=0.001$) ile hem sağ hem de sol omuz fleksiyonunda (sırasıyla $p=0.045$ ve $p=0.03$) daha etkili sonuçlar verirken, BDMG depresyon için daha etkiliydi ($p=0.005$). Gruplar arasında sabah tutukluğu, hassas nokta sayısı, anksiyete, omuz abdüksiyonu veya uyku kalitesi açısından anlamlı bir fark bulunmadı ($p>0.05$).

Sonuç: Hem elektroakupunktur hem de BDM, FMS semptomlarını iyileştirmede etkili müdahalelerdir. EA, endojen opioid yolakları aracılığıyla daha etkili bir ağrı modülasyonu gösterirken; BDM, otonomik modülasyon yoluyla depresif semptomları azaltmada daha etkilidir. Bu bulgular, FMS'de tedavi seçiminin bireyselleştirilmesi gerektiği görüşünü desteklemektedir.

Anahtar Kelimeler: *Ağrı eşiği, sabah tutukluğu, depresyon, uyku kalitesi*

INTRODUCTION

Fibromyalgia syndrome (FMS) is a chronic and complex pain disorder associated with persistent and widespread musculoskeletal pain, fatigue, non-restorative sleep, cognitive impairment and a wide range of somatic symptoms (Giorgi et al., 2022, 2023). The pathophysiology of FMS involves abnormalities in central pain processing, including increased central sensitivity, altered descending inhibitory pathways, and neuroendocrine abnormalities (Siracusa et al., 2021). This syndrome affects approximately 2–4% of the global population. Prevalence is higher in women. It places a significant burden on patients' quality of life, functional capacity and psychological well-being (Giorgi et al., 2022, 2023).

Current pharmacological treatments for FMS, including serotonin-norepinephrine reuptake inhibitors, pregabalin and tricyclic antidepressants, can partially alleviate FMS symptoms but are associated with side effects that limit adherence to long-term treatment (Wolfe et al., 2016). This situation has led to growing interest in non-pharmacological complementary interventions that target the multidimensional nature of FMS symptoms.

Electroacupuncture (EA) is a treatment method that combines traditional manual acupuncture with electrical stimulation delivered via needles inserted into the body. The analgesic effects of EA are supported by robust preclinical and clinical evidence. Neurophysiologically, this method activates A-delta afferent fibers extending from the spinomesencephalic tract to the periaqueductal gray (PAG) in the midbrain. By acting on the μ-opioid receptors within the PAG, it stimulates the release of endogenous opioid peptides (particularly β-endorphin and enkephalin), which lift the inhibition of PAG projection neurons. This stimulation initiates descending inhibitory pathways via the rostroventromedial medulla (RVM) and locus coeruleus (LC), releasing serotonin and noradrenaline into the dorsal horn of the spinal cord. These neurotransmitters, released here, suppress nociceptive transmission via activation of 5-HT1A/5-HT3 and α2-adrenergic receptors, respectively (Lottering & Lin, 2021; Zhou et al., 2023). In addition, EA modulates microglial activation and reduces the release of pro-inflammatory cytokines (TNF-α, IL-1β, IL-6) in the central nervous system. This contributes to its anti-hyperalgesic effects (6). It has been shown that EA improves pain intensity, reduces the number of tender points and improves sleep quality in FMS patients (Deluze et al., 1992).

Connective tissue massage (CTM), also known as Bindegewebsmassage, is a specialized manual therapy technique. By applying shearing forces to the connective tissue interfaces beneath the skin within a specific reflex pattern, mechanoreceptors and interoceptors are stimulated. CTM produces analgesic, muscle-relaxing and thermogenic effects via reflexogenic mechanisms that also influence the autonomic nervous system. This intervention specifically activates parasympathetic tone while reducing sympathetic activity. This effect leads to a reduction in heart rate, improved peripheral circulation and a decrease in circulating cortisol levels (Er & Yüksel, 2023; Field, 2016). Furthermore, CTM's effective mechanical stimulation facilitates the release of endorphins, serotonin and dopamine—neurotransmitters that play a role in regulating mood and modulating stress resilience (Moyer et al., 2004). It has been reported that this method improves health-related quality of life, reduces pain intensity and enhances psychological well-being in patients with FMS (Ekici et al., 2009).

The individual efficacy of EA and CTM in FMS management has been recognized. However, these methods operate via different neurophysiological mechanisms. While EA primarily activates central descending pain inhibitory systems and endogenous opioid pathways, CTM predominantly modulates autonomic nervous system function and peripheral mechanoreceptor-mediated reflex pathways. Understanding the distinct effects of these two mechanically different interventions on the multidimensional symptom profile of FMS (sensory: pain threshold, pain intensity, number of tender points; physical: morning stiffness, range of motion; and emotional:

depression, anxiety, sleep quality) is crucial for evidence-based treatment selection and personalized care.

To the best of our knowledge, as of the date of this study, no comparative randomized controlled trial has investigated the effects of EA and CTM on pain threshold, pain intensity, morning stiffness, number of tender points, depression, anxiety, active shoulder range of motion and sleep quality in patients with FMS. Therefore, the primary aim of this study was to compare the efficacy of EA and CTM on these symptoms. Our hypothesis is: (i) Both interventions will result in significant improvements in pain and functional outcomes compared to baseline; (ii) EA will demonstrate superior efficacy in modulating pain threshold and pain intensity via central opioid and descending inhibitory mechanisms; and (iii) CTM will produce greater positive effects on psychological symptoms via autonomic and neuroendocrine modulatory effects.

METHOD

The interventions included in the study were carried out between October 1995 and March 1998 at the Department of Physical Medicine and Rehabilitation, Yüzüncü Yıl University Faculty of Medicine Hospital. This research was designed as a single-center, assessor-blinded, parallel-group, randomized controlled trial. As the university's ethics committees had not yet been established at that time, ethical approval could not be obtained. The study was conducted in strict accordance with the Declaration of Helsinki, and all participants provided written informed consent prior to enrollment.

Participants

A total of 60 patients (47 females, 13 males) diagnosed with FMS by a physiatrist with approximately three years' experience at the Department of Physical Medicine and Rehabilitation were included in the study. The diagnosis of the patients was made according to the 1990 American College of Rheumatology criteria (Wolfe et al., 1990), which require the presence of chronic widespread pain and tenderness on palpation at 11 or more of the previously specified 18 tender points.

Inclusion criteria: Meeting the 1990 ACR FMS criteria; presence of chronic cervicodorsal pain lasting for more than two months; being aged between 18 and 65 years.

Exclusion criteria: Having received pharmacological pain treatment within the last three months; the presence of systemic bone or joint diseases; having received acupuncture or connective tissue massage within the last six months; the presence of a significant psychiatric disorder requiring pharmacological treatment; and an inability to communicate verbally.

Randomization and Blinding

Participants were divided into blocks of five according to age, gender, duration of illness, baseline pain intensity (VAS) and number of tender points. Within each block, participants were randomly assigned in a 1:1 ratio to either the electroacupuncture group (EAG, n=30) or the connective tissue massage group (CMG, n=30) using a computer-generated randomization sequence. The randomization sequence was concealed in sequentially numbered, opaque, sealed envelopes. The outcome assessors were blinded to group allocation. Due to the nature of the interventions, the physiotherapist and physiatrist could not be blinded. However, they were instructed not to discuss the details of the interventions with the assessors or participants. The flow of participants through enrollment, allocation, follow-up and analysis is summarized in the CONSORT flow diagram (Figure 1).

Interventions

Electroacupuncture interventions were administered by a physiatrist holding a certificate in acupuncture practice. Sterile, single-use silver acupuncture needles (0.25 mm × 40 mm) were inserted into tender points selected according to each patient's pain pattern, as well as the traditional acupuncture points BL-54 (Zhi Bian), BL-40 (Wei Zhong), BL-11 (Da Zhu) and GB-19 (Nao Kong). The needles were inserted at a 45° angle to a depth of 10-25 mm (7). Electrical stimulation was administered using the Acuset SMS-205 electroacupuncture device, set to a frequency of 1–20 Hz and a peak intensity of 10 mA, to produce painless, visible muscle contractions. Each session lasted 20 minutes. The interventions were administered at a rate of 5 sessions per week, totaling 20 sessions.

CTM was administered by an experienced physiotherapist trained in the Bindegewebsmassage technique. The massage was applied to the scapular, interscapular, neck, nape, chest, deltoid and forehead regions, targeting areas of tension, tenderness or pain. During the intervention, specific tapping patterns were used to create shear forces at the skin-connective tissue interfaces within a reflexogenic sequence. Each session lasted 20 minutes. The treatments were administered five times a week over a four-week period, totaling 20 sessions, in line with the EAG program.

Outcome Measures

Assessments were conducted by a blinded assessor at the start of the study and immediately after the final intervention, for a total of two times. To ensure consistency, patients were seated in a standard position (knees and hips flexed at 90°, trunk and head upright) during the assessment.

Primary Outcome Measures:

1. Pain Threshold (PT): Assessed using an algometer (PTM, NY, USA) with 10 cervicodorsal tender points defined in FMS (The first tender point number in parentheses refers to the right side, and the second to the left side): (i) bilateral suboccipital muscle insertions (Tender point (TP) 1 and 2); (ii) anterior C5–C7 intertransverse spaces (TP 3 and 4); (iii) the midpoint of the upper trapezius line (TP 5 and 6); (iv) the upper inner corner of the scapula (TP 7 and 8); and (v) the point lateral to the upper part of the second costochondral joint (TP 9 and 10). Vertical pressure was applied at a rate of approximately 10 g/mm²/second to each region until the participant reported pain (the pain threshold is defined as the pressure at which pain is first perceived and is recorded in g/mm²). The algometer has demonstrated good intra-rater reliability and validity in assessing the pressure pain threshold in FMS (Fischer, 1987).

2. Pain Intensity (PI): This was assessed using a Visual Analogue Scale (VAS), a 10 cm horizontal line. Participants marked the point corresponding to their current maximum pain intensity. The VAS is a valid and reliable tool for assessing pain intensity (Price et al., 1983).

3. Number of Tender Points (NTP): This was determined by applying a pressure of approximately 40 g/mm² (equivalent to the standard 4 kg/cm² ACR pressure) with an algometer to each of the 10 tender points defined in the FMS. The number of points at which the participant reported pain was recorded.

Secondary Outcome Measures

4. Duration of Morning Stiffness: Participants reported, in minutes, how long the cervicodorsal stiffness they experienced after waking in the morning persisted.

5. Depression: This was assessed using the Beck Depression Inventory (BDI), a 21-item self-report questionnaire measuring depressive symptoms and attitudes. The reliability and validity of the BDI have been established in Turkish populations (Hisli, 1989).

6. Anxiety: This was assessed using the Beck Anxiety Inventory (BAI), a 21-item self-report questionnaire measuring anxiety severity.

7. Active Shoulder Joint Range of Motion: The active flexion and abduction angles of both shoulder joints were measured up to the pain threshold using a universal goniometer (360° model), a validated and reliable instrument (Riddle et al., 1987).

8. Sleep Quality: Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a 19-item self-report questionnaire designed to evaluate sleep quality over a one-month period. Higher scores indicate poorer sleep quality. The Turkish version of the PSQI has demonstrated good validity and reliability (Ağargün et al., 1996).

Statistical Analysis

Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as mean ± standard deviation (SD) for continuous variables and frequencies for categorical variables. The Shapiro-Wilk test was used to assess the normality of the distribution. For within-group comparisons, the paired Student's t-test was used for normally distributed parametric data, and the Wilcoxon signed-rank test was used for non-parametric data that were not normally distributed. For between-group comparisons, the independent Student's t-test (two-tailed) was used for parametric data, and the Mann-Whitney U test was used for non-parametric data. Between-group effect sizes were quantified using Cohen's d, interpreted using conventional thresholds (small ≥ 0.2, medium ≥ 0.5, large ≥ 0.8). A p-value of <0.05 was considered statistically significant for all analyses.

RESULTS

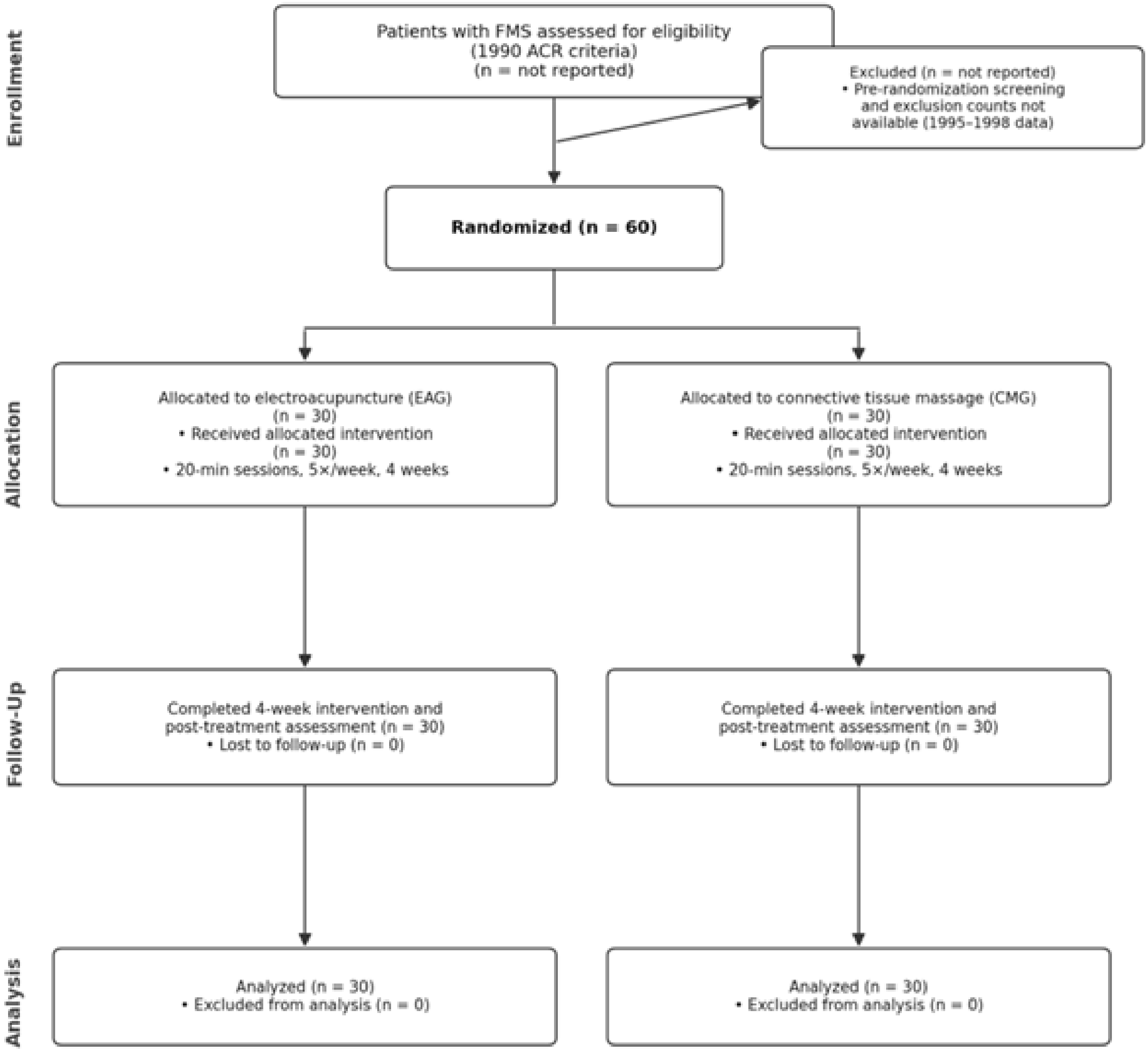
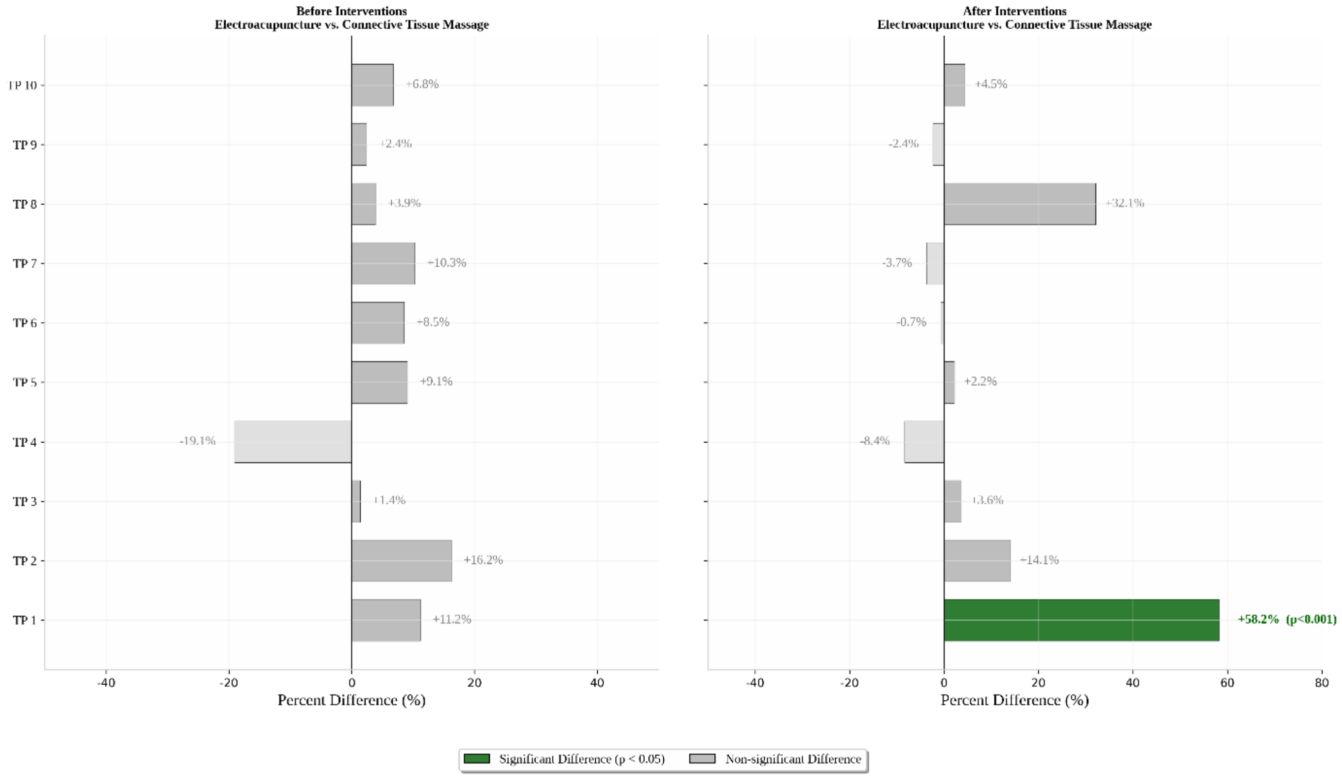


Figure 1. CONSORT flow diagram of participant enrollment, allocation, follow-ıp, and analysis.

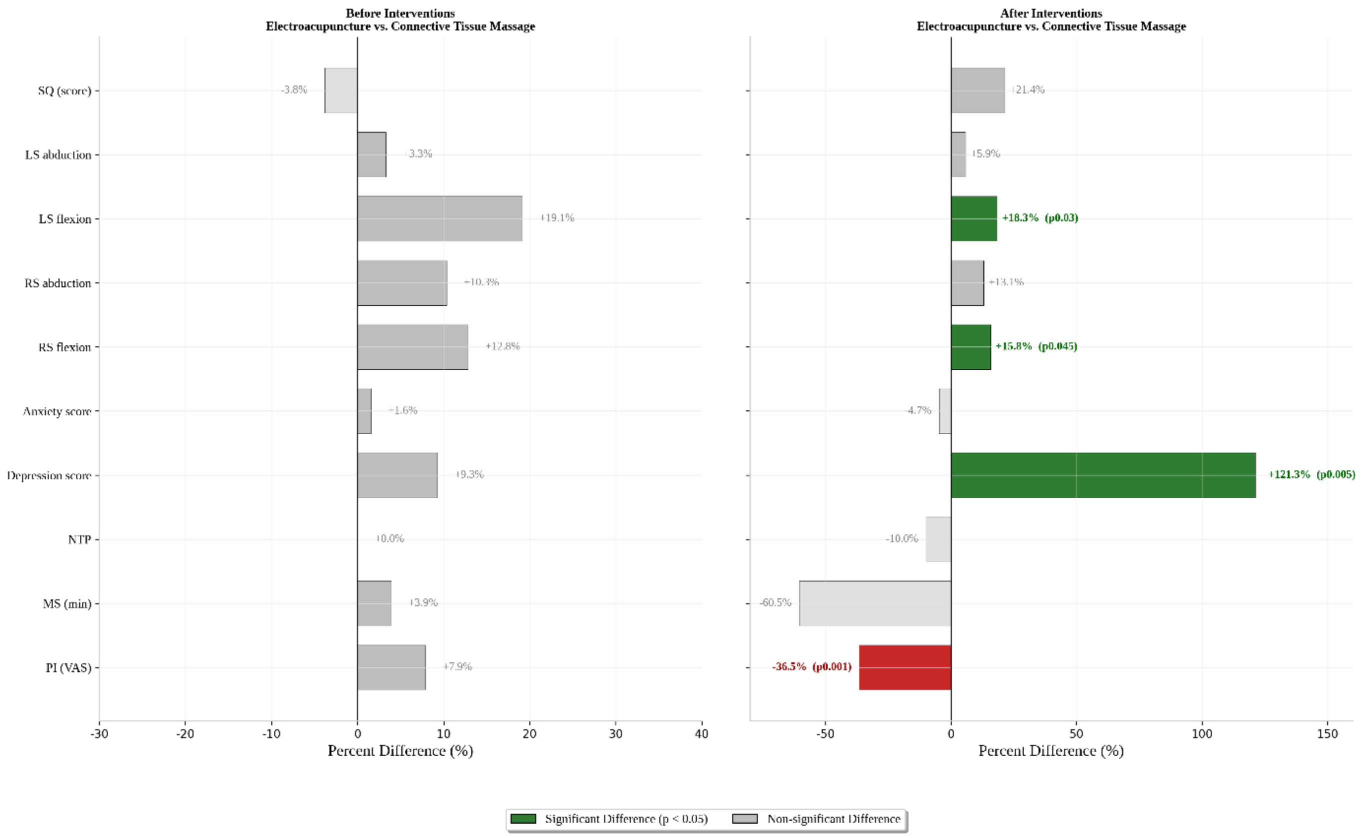
PSQ: sleep quality; LS: left shoulder; RS: right shoulder; NTP: number of tender points; MS: morning stiffness; PI: pain intensity; TP: tender point.

Figure 2. Percentage changes in all variables for both groups (Dark colors=p<0.05 significant difference).



TP: tender point

Figure 3. Intergoup comparisons of pain threshold data (Percentage difference: Electroacupuncture to connective tissue massage).



SQ: sleep quality; LS: left shoulder; RS: right shoulder; NTP: number of tender points; MS: morning stiffness; PI: pain intensity.

Figure 4. Intergoup comparisons of evaluation data (Percentage difference: Electroacupuncture to connective tissue massage).

Table 1. Demographic and clinical characteristics of the participants

	EAG* m±sd	CMG* m±sd	p
Female/male ratio	25/5	22/8	-
Age (years)	30.8 ±9.2	32.6 ±8.3	0.42
Disease duration (years)	2.8 ±3	3.6 ±3.6	0.35
Pain intensity (VAS)	8.2 ±1.8	7.6 ±1.9	0.25
Morning stiffness (min.)	50.6 ±19.7	48.7 ±17.2	0.91
NTP	7.43 ±2.3	7.43 ±1.9	1.0**
Depression score	17.7 ±9.1	16.2 ±5.2	0.43
Anxiety score	25.9 ±4.5	25.5 ±5.4	0.67**
Sleep quality	7.6 ±4.8	7.9 ±2.8	0.85

EAG; electroacupuncture group, CMG; connective tissue massage group, p; independent Student’s t-test, **; Mann-Whitney U test, m; mean, sd; standard deviation, VAS; visual analog scale, NTP; number of tender points, *n=30.

Table 2. Pain threshold values of the participants' tender points (gr/mm²).

	EAG* m±sd	CMG* m±sd	p
TP 1	269 ±80	242 ±43	0.08
TP 2	265 ±94	228 ±44	0.057
TP 3	220 ±78	217 ±45	0.83
TP 4	233 ±85	288 ±85	0.45**
TP 5	253 ±87	232 ±50	0.24
TP 6	254 ±97	234 ±85	0.40
TP 7	279 ±91	253 ±37	0.14**
TP 8	268 ±85	258 ±60	0.56
TP 9	255 ±76	249 ±37	0.71**
TP 10	268 ±83	251 ±40	0.29

EAG; electroacupuncture group, CMG; connective tissue massage group, m;mean, sd; standard deviation, TP; tender point, p; independent Student’s t-test, **; Mann-Whitney U test, m; mean, sd; standard deviation *n=30.

Table 3. Patients' active joint angle values.

	EAG* m±sd	CMG* m±sd	p
Right shoulder flexion (°)	132 ±53	117 ±58	0.12
Right shoulder abduction (°)	128 ±53	116 ±57	0.29**
Left shoulder flexion (°)	137 ±54	115 ±54	0.74**
Left shoulder abduction (°)	126 ±53	122 ±49	0.43

EAG; electroacupuncture group, CMG; connective tissue massage group, m; mean, sd; standard deviation, *n=30, °; degree, p; paired student's t-test, **; Wilcoxon signed-rank test.

Table 4. Within-group comparisons of data.

	Electroacupuncture group*			Connective tissue massage group*		
	Before interventions	After interventions		Before interventions	After interventions	
Variables	m±sd	m±sd	p	m±sd	m±sd	p
Pain thresholds of tender points (gr / mm²)						
TP 1	269 ±80	375±132	***<0.001***	242 ±43	237±45	0.7
TP 2	265 ±94	308±106	0.10	228 ±44	270±58	***0.003***
TP 3	220 ±78	287±81	***0.002***	217 ±45	277±59	***<0.001***
TP 4	233 ±85	284±110	***0.05****	288 ±85	310±112	0.75**
TP 5	253 ±87	277±98	0.32	232 ±50	271±85	***0.03***
TP 6	254 ±97	297±130	0.15	234 ±85	299±97	***0.007***
TP 7	279 ±91	286±102	0.79**	253 ±37	297±80	0.08**
TP 8	268 ±85	399±110	0.23	258 ±60	302±91	***0.03***
TP 9	255 ±76	290±73	0.07**	249 ±37	297±60	***0.01****
TP 10	268 ±83	305±100	0.12	251 ±40	292±84	***0.01***
PI (VAS)	8.2 ±1.8	3.3±1.8	***<0.001***	7.6 ±1.9	5.2±2.3	***0.00***
MS (minu)	50.6 ±19.7	20.8±100	0.06	48.7 ±17.2	52.6±15.4	0.83
NTP	7.43 ±2.3	4.5 ±2.3	***<0.001***	7.43 ±1.9	5 ±2.3	***<0.00****
Depression score	17.7 ±9.1	10.4 ±8.9	***0.003***	16.2 ±5.2	4.7 ±5.3	***<0.001***
Anxiety score	25.9 ±4.5	24.5 ±5.4	0.11	25.5 ±5.4	25.7 ±5.6	0.87**
Active joint motion angle (degrees)						
RS flexion	132 ±53	154 ±32	0.059	117 ±58	133 ±46	0.22
RS abduction	128 ±53	147 ±38	0.12	116 ±57	130 ±47	0.31**
LS flexion	137 ±54	155 ±35	0.12	115 ±54	131 ±49	0.23**
LS abduction	126 ±53	144 ±40	0.14	122 ±49	136 ±43	0.22
SQ (score)	7.6 ±4.8	5.1±3.6	***0.024***	7.9 ±2.8	4.2±2.2	***<0.001***

*n=30, p; paired student's t-test, **; Wilcoxon signed-rank test, m; mean, sd; standard deviation, VAS; visual analog scale, MS; morning stiffness, NTP; number of tender points, PI; pain intensity, RS; right shoulder, LS; left shoulder, SQ; sleep quality.

Table 5. Intergroup comparisons of pain threshold data

	Before interventions			After interventions		
	EAG*	CMG*		EAG*	CMG*	
Variables	m±sd	m±sd	p	m±sd	m±sd	p
Pain thresholds of tender points (gr / mm²)						
TP 1	269 ±80	242 ±43	0.08	375±132	237±45	***<0.001***
TP 2	265 ±94	228 ±44	0.057	308±106	270±58	0.09
TP 3	220 ±78	217 ±45	0.83	287±81	277±59	0.58
TP 4	233 ±85	288 ±85	0.45	284±110	310±112	0.36**
TP 5	253 ±87	232 ±50	0.24	277±98	271±85	0.77
TP 6	254 ±97	234 ±85	0.4	297±130	299±97	0.92
TP 7	279 ±91	253 ±37	0.14	286±102	297±80	0.65**
TP 8	268 ±85	258 ±60	0.56	399±110	302±91	0.37
TP 9	255 ±76	249 ±37	0.71	290±73	297±60	0.68**
TP 10	268 ±83	251 ±40	0.29	305±100	292±84	0.59

EAG; electroacupuncture group, CMG; connective tissue massage group, *n=30, m; mean, sd ; standard deviation, p; independent Student's t-test, **; Mann-Whitney U test, TP; tender point.

Table 6. Intergroup comparisons of evaluation data.

	Before interventions			After interventions		
	EAG*	CMG*		EAG*	CMG*	
Variables	m±sd	m±sd	p	m±sd	m±sd	p
PI (VAS)	8.2 ±1.8	7.6 ±1.9	0.25	3.3±1.8	5.2±2.3	***0.001***
MS (min)	50.6 ±19.7	48.7 ±17.2	0.91	20.8±100	52.6±15.4	0.06
NTP	7.43 ±2.3	7.43 ±1.9	1.00	4.5 ±2.3	5 ±2.3	0.35**
Depression score	17.7 ±9.1	16.2 ±5.2	0.43	10.4 ±8.9	4.7 ±5.3	***0.005***
Anxiety score	25.9 ±4.5	25.5 ±5.4	0.67	24.5 ±5.4	25.7 ±5.6	0.41**
Active joint motion angle (degrees)						
RS flexion	132 ±53	117 ±58	0.29	154 ±32	133 ±46	**0.045**
RS abduction	128 ±53	116 ±57	0.43	147 ±38	130 ±47	0.13**
LS flexion	137 ±54	115 ±54	0.12	155 ±35	131 ±49	***0.03****
LS abduction	126 ±53	122 ±49	0.74	144 ±40	136 ±43	0.46
SQ (score)	7.6 ±4.8	7.9 ±2.8	0.85	5.1±3.6	4.2±2.2	0.25

EAG; electroacupuncture group, CMG; connective tissue massage group, *n=30, m; mean, sd ; standard deviation, p; independent Student's t-test, **; Mann-Whitney U test, PI; pain intensity, MS; morning stiffness, NTP; number of tender points,VAS; visual analog scale, min; minute, RS; right shoulder, LS; left shoulder, SQ; sleep quality.

Demographic and basic clinical characteristics of the EAG and CMG are presented in Tables 1, 2, and 3. There were no significant differences between the groups in terms of age (EAG: 30.8 ± 9.2 years, CMG: 32.6 ± 8.3 years; p = 0.42), gender distribution (EAG: 25 women/5 men, CMG: 22 women/8 men), duration of illness (EAG: 2.8 ± 3.0 years; CMG: 3.6 ± 3.6 years; p = 0.35), baseline pain intensity (EAG: 8.2 ± 1.8; CMG: 7.6 ± 1.9; p = 0.25), duration of morning stiffness (EAG: 50.6 ± 19.7 min, CMG: 48.7 ± 17.2 min; p = 0.91) and number of tender points (EAG: 7.43 ± 2.3, CMG: 7.43 ± 1.9; p = 1.00). No significant differences were observed in depression scores (EAG: 17.7 ± 9.1, CMG: 16.2 ± 5.2; p = 0.43), anxiety scores (EAG: 25.9 ± 4.5, CMG: 25.5 ± 5.4; p = 0.67) or sleep quality scores (EAG: 7.6 ± 4.8, CMG: 7.9 ± 2.8; p = 0.85). These findings confirm the success of the randomization procedure and the comparability of the groups' baseline values.

Intra-group Treatment Effects

Table 4 and Figure 2 present the pre- and post-treatment data within each group. In the EAG group, significant increases in pain threshold were observed at points 1 (p < 0.001), 3 (p = 0.002) and 4 (p = 0.05); in the CMG group, significant increases were observed at points 2 (p = 0.003), 5 (p = 0.03), 6 (p = 0.007), 8 (p = 0.03), 9 (p = 0.01) and 10 (p = 0.01). Significant improvements were observed in tender point 3 in both groups. In tender point 7, however, no significant change was observed in either group (p > 0.05).

Significant reductions were observed in pain intensity (EAG: p < 0.001; CMG: p < 0.001) and the number of tender points (EAG: p < 0.001; CMG: p < 0.001) in both groups. Depression scores decreased significantly in both groups (EAG: p = 0.003; CMG: p < 0.001), while there was no significant change in anxiety scores (EAG: p = 0.11; CMG: p = 0.87). Sleep quality improved significantly in both groups (EAG: p = 0.024; CMG: p < 0.001). Morning stiffness duration and shoulder range of motion showed no significant changes within the groups, apart from a trend toward improvement in right shoulder flexion in the EAG group (p = 0.059) (p > 0.05 for all comparisons).

Intergroup Comparisons

Table 5 and Figure 3 present the intergroup pain threshold data following treatment. The pain threshold for tender point 1 was significantly higher in the EAG group than in the CMG group (p < 0.001, d = 1.40). No significant differences were observed between the groups for the other tender points (p > 0.05).

Table 6 and Figure 4 present the intergroup comparisons of treatment effects. The EAG group showed a significantly greater reduction in pain intensity than the CMG group (p = 0.001, d = 0.92). In contrast, the CMG group showed a significantly greater reduction in depression scores than the EAG group (p = 0.005, d = 0.78). Furthermore, the EAG group showed a significantly greater increase in both right and left shoulder flexion than the CMG group (p = 0.045, d = 0.53 and p = 0.03, d = 0.56, respectively). Effect sizes for the remaining, non-significant between-group comparisons (morning stiffness, number of tender points, anxiety, shoulder abduction and sleep quality) were small (d < 0.5; p > 0.05 for all).

DISCUSSION

This study compared the efficacy of electroacupuncture (EA) and connective tissue massage (CTM) in patients with fibromyalgia syndrome (FMS). The data indicate that both interventions led to significant improvements in pain threshold, number of tender points, pain intensity, depression and sleep quality. However, EA was more effective in raising the pain threshold and reducing pain intensity, while CTM was more effective in alleviating depressive symptoms. The magnitude of these between-group differences was clinically meaningful: effect sizes were large for pain threshold (d = 1.40) and pain intensity (d = 0.92) in favor of EA, and medium for depression (d = 0.78) in favor of CTM. These differing effects may be attributed to distinct neurophysiological mechanisms through which the two interventions modulate the complex pathophysiology of FMS.

Analgesic Effects of Electroacupuncture

The fact that electroacupuncture produces a significantly greater increase in pain threshold and a greater reduction in pain intensity compared to CTM is consistent with the well-established neurophysiological mechanisms of acupuncture analgesia. EA activates A-delta afferent fibers ascending to the periaqueductal gray matter (PAG) in the midbrain via the spinomesencephalic tract. The low-frequency EA (1–20 Hz) used in this study primarily stimulates the release of β-endorphin and enkephalin within the PAG. This, in turn, disinhibits PAG projection neurons by acting on μ-opioid receptors. This activation triggers descending inhibitory pathways via the rostroventromedial medulla (RVM) and locus coeruleus (LC), leading to the release of serotonin (5-HT) and norepinephrine (NE). These monoamines suppress nociceptive transmission by activating inhibitory 5-HT1A/5-HT3 and α2-adrenergic receptors on second-order neurons and primary afferent terminals (Kim et al., 2023; Wang et al., 2018). Furthermore, EA modulates microglial activation and reduces the release of pro-inflammatory cytokines (TNF-α, IL-1β, IL-6) in the spinal cord, thereby alleviating central sensitization, a hallmark of the FMS pathophysiology (Wang et al., 2018; Ali et al., 2020).

Our findings are consistent with previous clinical studies demonstrating the efficacy of EA in FMS. Deluze et al. (Deluze et al., 1992) reported that, compared with sham acupuncture, EA significantly reduced pain intensity and improved general well-being in patients with FMS. Similarly, a recent systematic review and meta-analysis by Cheng et al. (Cheng et al., 2023) concluded that electrical neuromodulation, including EA, leads to significant reductions in pain intensity and improvements in functional status in FMS. The magnitude of the reduction in pain intensity observed in our EAG study (a 4.9-point reduction on the VAS) exceeds the minimum clinically important difference (MCID) of approximately 1.5–2.0 points for FMS (Dworkin et al., 2008), indicating that the observed effect is not only statistically significant but also clinically meaningful.

The frequency-specific effects of electroacupuncture are noteworthy. It has been shown that the low-frequency stimulation (1–20 Hz) used in this study primarily activates the hypothalamic arcuate nucleus, thereby promoting the release of β-endorphin into the cerebrospinal fluid and the bloodstream, while also stimulating the PAG-RVM axis. In contrast, high-frequency EA (>100 Hz) primarily activates the dynorphin/κ-opioid receptor system in the dorsal horn (Han, 2011). Therefore, the selection of low-frequency parameters in our study was appropriate for targeting the central descending inhibitory pathways that play a mechanistic role in FMS pain.

The Effects of Connective Tissue Massage on Psychological Symptoms

It is noteworthy that connective tissue massage (CTM) resulted in a greater reduction in depression scores than EA (reduction in the BDI: 11.7 units versus 7.3 units). This striking effect can be explained by the distinct physiological effects of CTM on the autonomic nervous system and the hypothalamic-pituitary-adrenal (HPA) axis. CTM activates the parasympathetic nervous system while reducing sympathetic tone by stimulating mechanoreceptors and interoceptors in the connective tissue (Calik et al., 2024). This autonomic shift is associated with a reduction in heart rate, improved peripheral circulation, and a decrease in circulating cortisol levels (Field, 2016; Moyer et al., 2004). In patients with FMS, the HPA axis frequently functions irregularly, and evidence of both hyper- and hypocortisolism is present. The stress-buffering effects of massage interventions, however, appear to normalize impaired HPA axis function over time (Pariante & Lightman, 2008). In addition to this effect, it has been shown that CTM increases circulating levels of neurotransmitters such as serotonin, dopamine and endorphins, which play a critical role in mood regulation, reward processing and emotional resilience (Moyer et al., 2004). The tactile stimulation and therapeutic touch specific to CTM may also support feelings of safety, trust and emotional well-being by activating oxytocin release (Schneider et al., 2023). Although these mechanisms produce less pronounced analgesic effects compared to EA, they may explain why CTM exhibits superior interactions in reducing depressive symptoms.

Our findings regarding connective tissue massage and depression are consistent with the literature on massage therapy for FMS. Yuan et al. (Yuan et al., 2015) conducted a systematic review and meta-analysis on massage therapy for FMS and reported that various massage techniques, including connective tissue massage, provided significant improvements in pain, anxiety and depression. However, it is important to note that the meta-analysis did not demonstrate the superiority of CTM over other massage techniques; rather, it showed that massage therapy is generally beneficial. Ekici et al. (Ekici et al., 2009) compared CTM with manual lymphatic drainage therapy (MLDT) in women with FMS. They reported that both methods improved pain intensity, pain pressure threshold and health-related quality of life; however, MLDT demonstrated superiority in some subscales of the Fibromyalgia Impact Questionnaire. These findings suggest that, although CTM is effective, claims regarding its superiority over other massage techniques require validation through comparative studies with sufficient statistical power.

Comparative Efficacy and Clinical Implications

The differing efficacy data observed in the outcomes of EA and CTM interventions in this study have significant clinical implications for personalized FMS management. FMS exhibits heterogeneous prevalence, with symptom predominance varying significantly among patients. While some patients present with pain as their primary complaint, others report more problems due to fatigue, sleep disturbances, or psychological comorbidities (Giorgi et al., 2022, 2023). Given its pronounced positive effects on pain threshold and pain intensity, the current findings suggest that EA may be primarily suitable for patients with significant pain and hyperalgesia. Conversely, given CTM's more dominant effect on psychological well-being and stress physiology, it may be a more suitable method for patients with significant depressive symptoms or autonomic dysfunction.

The lack of significant intergroup differences in the reduction of tender point number, improvement in sleep quality, and reduction in anxiety among both groups demonstrates that both interventions are broadly effective in multiple symptoms of FMS and have specific advantages in different symptom clusters. The domain-specific efficacy of the interventions supports a multidimensional treatment approach where the appropriate intervention is selected according to the patient's dominant symptom profile and is consistent with current recommendations for personalized FMS care (Wolfe et al., 2016).

Morning Stiffness and Range of Motion

Neither intervention produced significant within-group changes in the duration of morning stiffness or shoulder range of motion; however, the between-group analysis favored EA for both right and left shoulder flexion. These findings were partly expected. Morning stiffness in FMS is thought to reflect non-inflammatory mechanisms, including altered muscle metabolism, deconditioning, and central sensitivity, rather than inflammatory synovitis, which is characteristic of rheumatoid arthritis (Mathkhor & Ibraheem, 2023). Similarly, range of motion of the shoulder in FMS is often limited by pain inhibition and muscle protection rather than true joint restriction. This results in active joint ranges of motion being less responsive to treatment compared to structural joint pathologies (Shridhar & Alam, 2026). Kim et al. (Kim et al., 2020) reported that EA improved hip joint mobility in healthy individuals after a single session. However, the absence of a similar effect in our FMS population may reflect the increased muscle tension and central sensitivity present in these patients. Longer or more intensive interventions may be needed to overcome this.

CONCLUSION

The results of this randomized controlled trial demonstrate that electroacupuncture and connective tissue massage are effective complementary interventions for fibromyalgia syndrome, although they have different interaction profiles. Electroacupuncture exhibits superior analgesic effects, likely through activation of endogenous opioid systems and reduced pain inhibition pathways. Connective tissue massage, on the other hand, shows greater efficacy in alleviating depressive symptoms, likely through parasympathetic activation and modulation of stress-sensitive neuroendocrine systems. These findings support an individualized, symptom-focused approach to FMS management, considering the patient's dominant clinical profile in treatment selection. Future research should be designed as placebo-controlled trials with larger sample sizes, longer follow-up periods, and mechanistic biomarker assessments to elucidate the comparative efficacy and underlying neurophysiological mechanisms of these interventions in more detail.

This study was conducted retrospectively using data obtained from a master's thesis (Thesis No: 70596) published on the Higher Education Council's Thesis Center website.

Limitations

Several limitations of this study are evident. First, while the sample size (n=30 per group) was sufficient to detect large effects, it may have been insufficient to detect smaller but clinically significant differences in outcomes, such as in the data for anxiety and sleep quality. Second, there was no sham control group. This prevents drawing definitive conclusions about the specific efficacy of EA and CTM beyond placebo effects. Third, the study lacked long-term follow-up assessments, limiting inferences about the persistence of the intervention effects. Fourth, the single-center design and relatively homogeneous demographics (predominantly female, middle-aged) may limit the generalizability of the findings to larger FMS populations. Fifth, the study was conducted between 1995 and 1998, and diagnostic criteria for FMS have evolved since then. However, the 1990 ACR criteria used to diagnose participants in this study remain valid in terms of comparability of the research.

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