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The Impact of Music on Frozen Shoulder Management: Randomized Trial

Donuk Omuz Tedavisinde Müziğin Etkisi: Randomize Çalışma

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ABSTRACT Objective: While the effectiveness of conventional physiotherapy methods in the treatment of frozen shoulder (FS) is well established, the potential benefits of music have not yet been clearly determined. This study aimed to investigate the effects of incorporating music as an adjunctive therapy in the treatment of FS, focusing on its impact on pain, range of motion, functional status, and quality of life. **Material and Methods:** Forty subjects with FS and passive joint movement limited to 50-75% of the normal range were randomly assigned to 4 treatment groups: (1) music+mobilization+exercise, (2) music+exercise, (3) mobilization+exercise, and (4) exercise only. Treatments were conducted 3 times per week for 6 weeks. Pain (visual analog scale), range of motion (goniometer), functional condition (Disabilities of the Arm, Shoulder, and Hand Questionnaire), and quality of life [Short Form-36 (SF)-36] were assessed pre- and post-treatment. **Results:** Group 1 and Group 3 showed significant improvements in pain, range of motion, and quality of life ($p<0.05$), and achieved better functional outcomes compared to Groups 2 and 4 ($p<0.05$). All groups exhibited significant improvements in pain and range of motion following the intervention ($p<0.05$). Effect size analyses revealed large effects ($r>0.5$) for most outcome variables, supporting the efficacy of the applied interventions. **Conclusion:** This study suggests that music may provide potential benefits when used as a complementary component in FS rehabilitation. Although it did not significantly reduce pain, music positively influenced functional status and quality of life. The SF-36 results indicate that music may help reduce psychological distress and improve overall well-being, supporting its use as a supportive intervention in physiotherapy.

Keywords: Frozen shoulder; music; manual therapy; modified constant

ÖZET Amaç: Donuk omuz [frozen shoulder (FS)] tedavisinde, geleneksel fizyoterapi yöntemlerinin etkisi iyi bilinmekle birlikte, müziğin potansiyel faydaları henüz netlik kazanmamıştır. Bu çalışmanın amacı, müziğin FS tedavisinde tamamlayıcı bir yöntem olarak kullanılması durumunda ağrı, eklem hareket açıklığı, fonksiyonel durum ve yaşam kalitesi üzerindeki etkilerini incelemektir. **Gereç ve Yöntemler:** FS tanısı almış ve pasif eklem hareketi normalin %50-75'i ile sınırlı olan 40 birey rastgele 4 tedavi grubuna ayrıldı: (1) müzik+mobilizasyon+egzersiz, (2) müzik+egzersiz, (3) mobilizasyon+egzersiz ve (4) yalnızca egzersiz. Tedaviler haftada 3 kez olmak üzere 6 hafta boyunca uygulandı. Ağrı (görsel analog skala), eklem hareket açıklığı (gonyometre), fonksiyonel durum (Kol, Omuz ve El Engellilikleri Anketi) ve yaşam kalitesi [kısa formu-36 (short form "SF")-36] tedavi öncesi ve sonrası değerlendirildi. **Bulgular:** Grup 1 ve Grup 3'te ağrı, eklem hareket açıklığı ve yaşam kalitesinde anlamlı düzeyde iyileşme gözlenmiştir ($p<0,05$). Bu gruplar, fonksiyonel sonuçlar açısından Grup 2 ve Grup 4'e göre üstün bulunmuştur ($p<0,05$). Tüm gruplarda tedavi sonrasında ağrı ve hareket açıklığında anlamlı gelişmeler kaydedilmiştir ($p<0,05$). Etki büyüklüğü analizleri, birçok değişken için yüksek etki düzeyini ($r>0,5$) göstermiş ve uygulanan müdahalelerin etkinliğini desteklemiştir. **Sonuç:** Bu çalışma, müziğin FS rehabilitasyonuna potansiyel katkı sağlayabileceğini ortaya koymaktadır. Müzik, ağrıyı anlamlı ölçüde azaltmasa da, yaşam kalitesi ve fonksiyonel iyilik hâli üzerinde olumlu etkiler göstermiştir. SF-36 sonuçları, müziğin psikolojik sıkıntıları azaltabileceğini ve genel iyilik hâlini artırabileceğini düşündürmektedir. Bu bulgular, müziğin FS tedavisinde tamamlayıcı bir yaklaşım olarak kullanılmasını desteklemektedir.

Anahtar Kelimeler: Donuk omuz; müzik; manuel terapi; modifiye constant

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Frozen shoulder (FS), also known as adhesive capsulitis, is a common musculoskeletal disorder characterized by gradual onset of pain, restricted shoulder mobility, and functional limitations due to capsular stiffness and adhesions. It affects daily activities and quality of life, making effective rehabilitation essential. The primary movement limitation often involves external rotation, especially during abduction, caused by mechanical resistance beneath the acromion.[1]

Conventional physiotherapy, including joint mobilization and therapeutic exercises, remains the cornerstone of FS treatment. Techniques such as mobilization and strengthening of the rotator cuff and scapular muscles help improve shoulder function and reduce recurrence. Individualized rehabilitation programs that target proprioception and muscle strength have demonstrated better outcomes when combining mobilization with strengthening exercises compared to exercise alone.[2]

In recent years, complementary interventions such as music listening have gained attention in rehabilitation. Music can influence autonomic nervous system activity, reduce stress, enhance relaxation, and modulate pain perception by activating neural circuits involved in emotional and sensory processing.[3,4] Additionally, music has been associated with improvements in mood, sleep quality, heart rate variability, and overall psychological well-being in individuals with chronic pain and musculoskeletal conditions.[5]

Although music listening has been studied in various clinical populations, its potential role as a supportive intervention in FS rehabilitation remains underexplored. Integrating music listening into physical therapy protocols may enhance treatment outcomes by promoting relaxation, emotional regulation, and pain reduction.

The aim of this study is to evaluate the effects of music listening, when used alongside conventional physiotherapy, on pain, shoulder range of motion (ROM), functional status, and quality of life in individuals with FS.

MATERIAL AND METHODS

SUBJECTS

This single-blind, randomized trial was conducted at Ondokuz Mayıs University Department of Physical Therapy and Rehabilitation between May 2021-April 2022. The study was conducted in accordance with the Declaration of Helsinki, and by Ethics Committee of Ondokuz Mayıs University (date: April 29, 2021; no: 2021/234) and registered at ClinicalTrials.gov (August 25, 2023). Informed consent was obtained from all subjects involved in the study.

To determine the appropriate sample size for this scientific study, a statistical power analysis was performed using G*Power software. The analysis was based on the Wilcoxon signed-rank test, which is suitable for within-group comparisons. Power values were calculated for different sample sizes, assuming a 5% margin of error ($\alpha=0.05$). In line with the present study, effect size estimation was based on a reference study by Al Shehri et al, which investigated pain reduction using the visual analog scale (VAS).[5] The calculated effect size was $d=2.715$. Based on this large effect size, the power analysis indicated that a sample size of 20 participants would provide a statistically sufficient power level. A total of 48 female patients aged 30-65 years with stage 2 or 3 idiopathic FS were screened. Eight were excluded based on predefined criteria, and the remaining 40 participants were randomly assigned to 4 equal groups using a sealed-envelope method (Figure 1).

The inclusion criteria for this study were as follows: individuals diagnosed with idiopathic or primary FS in stage 2 or 3 of the condition; unilateral involvement; age between 30-65 years; normal radiographic findings within the last 12 months; no history of surgical intervention or manipulation under anesthesia on the affected shoulder; passive joint movement limited to 50-75% of the normal ROM; and no presence of hearing impairment.[6-8]

Following enrollment, participants were randomly assigned to 1 of 4 intervention groups: Group 1 received joint mobilization and exercise combined with listening to music; Group 2 received exercise and listening to music; Group 3 received mobilization and exercise; and Group 4 received exercise alone.

A sealed box containing cards numbered 1, 2, 3, and 4 was prepared, and each patient selected a card at random to determine their group assignment. Con-

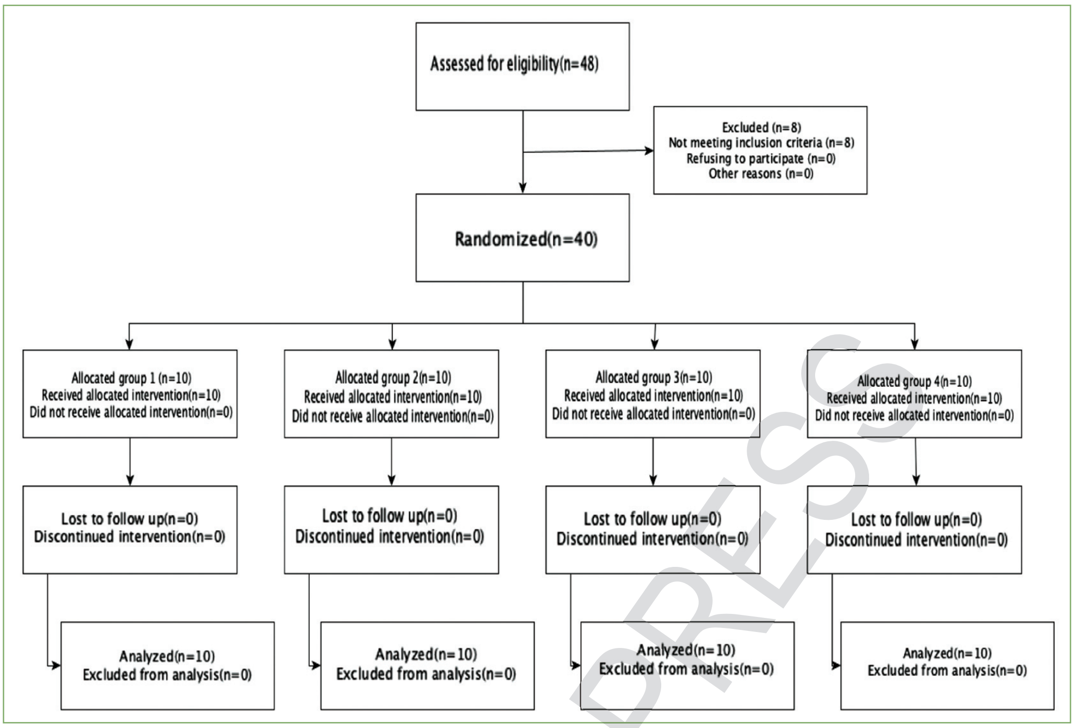

FIGURE 1: Flow diagram

sequently, Group 1 consisted of 10 participants, Group 2 had 10 participants, Group 3 had 10 participants, and Group 4 had 10 participants.

Tests and Measures

All treatment interventions were administered by the same physiotherapist, while a second physiotherapist conducted measurements before and after the treatment. Both physiotherapists were unaware of the group assignment of each subject; however, since the physiotherapist administering the treatments could infer the groups based on the treatments provided, blinding was only ensured for the physiotherapist conducting the measurements. Demographic information, including age, height, weight, and body mass index (BMI), was recorded for all patients.

Pain assessment included evaluation of resting pain, pain during activity, and night pain using the VAS. Participants were instructed that a score of "0" indicated "no pain", while "10" represented "the most severe pain imaginable". They marked their perceived pain intensity on a 10-centimeter horizontal line. The length in centimeters from the starting point to the mark was measured, providing a numerical value for pain severity.[9]

ROM of the shoulder -specifically flexion, abduction, internal rotation, and external rotation- was assessed actively and passively using a universal goniometer. Measurements were conducted with the patient in the supine position. Each movement was performed 3 times, and the mean of the recorded angular values, expressed in degrees, was used for analysis (Figure 2, Figure 3).[10]

In the present study, functional status was evaluated using two distinct questionnaires: the Disabilities of the Arm, Shoulder, and Hand (DASH) Questionnaire and the Modified Constant Shoulder Score. Muscle strength was measured using a portable hand dynamometer, and the quality of life was assessed through the Short Form-36 (SF-36) questionnaire.

The DASH Questionnaire, developed by the American Academy of Orthopaedic Surgeons in 1994, is designed to assess upper extremity function and symptom severity with an emphasis on physical capability.[11] It measures disability, activity limita-

FIGURE 2: Shoulder flexion range of motion

FIGURE 3: Shoulder rotation range of motion

tions, participation in leisure pursuits, and work-related restrictions due to upper limb impairments. The Turkish adaptation and validation of the tool was performed by Düger et al. in 2006.[12] The questionnaire comprises 30 items: 21 items assess challenges encountered in daily activities, 5 items evaluate symptom severity, and 4 items focus on social participation, sleep quality, work activities, and self-confidence. Each statement is rated using a 5-point Likert scale (1=no difficulty, 5=unable to perform). Scores are calculated on a scale of 0 to 100, with higher scores indicating greater disability.

The Modified Constant Shoulder Score is a composite tool that assesses several dimensions of shoulder health, including pain, daily function, mobility, and strength. The evaluation includes pain (15 points), performance in daily tasks (20 points), ROM (40 points), and muscle strength (25 points). Participants completed the assessment under the guidance of a physiotherapist, and each component was scored accordingly. Based on the total score, outcomes were classified as excellent (90-100), good (80-89), fair (70-79), or poor (<70). The Turkish validity and reliability of the modified version has been established.[13]

The SF-36 Health Survey is a general instrument frequently employed to evaluate quality of life. The Turkish version was validated by Koçyiğit et al. in 1999.[14] The tool includes 36 items covering 2 main domains -physical and mental health- as well as 8 specific dimensions: physical functioning, emotional role, social functioning, physical role, mental health, pain, general health, and vitality. Each subscale is scored between 0-100, where 0 indicates the lowest and 100 the highest perceived health status.[15] In this study, SF-36 scoring was performed via the official calculation platform at http://www.rand36calculator.com, based on the percentage values corresponding to participant responses.

Intervention

Therapy and Rehabilitation Clinic. All interventions were administered by a physiotherapist with 25 years of clinical experience and a Cyriax mobilization certificate. The treatment protocol for all patients included hot packs, transcutaneous electrical nerve stimulation (TENS), and a home exercise program. Additionally, specific mobilization, exercise, and music interventions were exclusively applied to the patients in their respective treatment groups. Furthermore, each subject received a written explanation on how to protect the affected arm during their daily activities. The treatment duration was 6 weeks, with sessions held 3 days per week, each lasting 50 minutes. Data were collected through 2 evaluations, one conducted at the beginning and the other at the end of the treatment period.

Conventional TENS (30 min) was applied with 4 electrodes. Frequency: 60-120 Hz; pulse width: 20-120 microsecond Intensity was adjusted for comfortable tingling without muscle contraction. Hot packs (20 min) were applied to the shoulder and scapular region.

Group 1 and Group 2 listened to music (Relaxing Celtic music-Relax Mind Body: Cleanse Anxiety, Stress&Toxins. Beautiful ambient music) via MP3 player and headphones during the 50-minute sessions. The sound intensity (decibel) during the music listening sessions was not measured or standardized. The volume level was adjusted individually according to each participant's comfort to ensure a relaxed listening experience. After listening to the music, participants were verbally asked whether they liked it, and no negative feedback was received from any of them. Individual comfort and satisfaction regarding music preferences were prioritized, and in the case of any negative feedback, a change of music was planned. Patients were instructed to focus solely on the music.

Groups 1 and 3 received Cyriax-based gliding mobilizations to the glenohumeral, scapulothoracic, acromioclavicular, and sternoclavicular joints (Figure 4, Figure 5). Techniques included posterior, anterior, and caudal glides, as well as scapular and clavicular joint mobilizations. Deep transverse friction massage was applied to the bicipital groove and serratus anterior. Each mobilization session lasted 15 minutes, applied 3 times per week. Intensity was tailored to individual tolerance.

All participants received supervised GH and scapular mobilization exercises, stretching, postural training, and a home exercise program (Thera-Band, finger ladder, posture exercises, twice daily, 10-15 reps).

FIGURE 4: Glenohumeral joint gliding

FIGURE 5: Scapula superior-inferior gliding

DATA ANALYSIS

The data were analyzed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics for quantitative variables were presented as mean±standard deviation. The Shapiro-Wilk test was employed to evaluate the assumption of normality for all variables. For demographic characteristics such as age, height, weight, and BMI, one-way analysis of variance with Fisher's F test was used when normal distribution criteria were met across all groups. If at least 1 group did not fulfill the normality assumption, the Kruskal-Wallis H test was applied as a non-parametric alternative.

For outcome measures including resting pain, activity-related pain, night pain, as well as active and passive ROM (flexion, abduction, internal and external rotation), Constant score, DASH score, and SF-36 subscales (physical functioning, vitality, mental health, social functioning, pain, general health perception, and health change), normality was assessed for both pre-treatment and post-treatment values. When normal distribution was confirmed, paired-sample t-tests were used for within-group comparisons. If the data were not normally distributed, the Wilcoxon signed-rank test was utilized.

To evaluate the effectiveness of Group 1, Group 2, Group 3, and Group 4 interventions, pre- and post-treatment differences were calculated for each variable, resulting in new difference scores. The distribution of these scores was then assessed separately for each group. Since normality was violated in at least 1 group (p<0.05), the Kruskal-Wallis H test was employed to analyze between-group differences across all outcome measures.

For the Kruskal-Wallis test, the within-group effect size was estimated based on the method outlined by Kazis et al.[16] The effect size was calculated using the formula: difference between pre- and post-treatment values divided by the standard deviation of the baseline measurement. Effect sizes were interpreted as follows: 0.20-0.50 denoted a small effect, 0.51-0.80 indicated a moderate effect, and values above 0.81 represented a large effect.[17] For the Wilcoxon signed-rank test, effect size calculations were performed in line with the recommendations of Fritz et al.[18] Additionally, the McNemar test was employed to evaluate changes in the categorical variables "Physical Role Difficulty" and "Emotional Role Difficulty".[19]

All statistical analyses were conducted using a 95% confidence interval, and significance was set at a p-value less than 0.05.

RESULTS

Table 1 indicates a significant difference between the groups in terms of height (p=0.025), whereas no differences were observed in age, weight, or BMI.

All groups showed significant improvements in pain and ROM measures post-treatment (p<0.05), except for some variables in Group 2 and Group 4. Specifically, Group 2 did not show significant improvement in DASH scores, and Group 4 showed no significant changes in physical function, energy-vitality, pain, or general health change scores on the SF-36 (Table 2).

Effect size analysis indicated the following findings: In Group 4, no significant effect was observed for energy-vitality and mental health (r=0), while a low effect (r<0.1) was found for the DASH outcome in Group 2. A moderate effect was noted for social functioning in Group 4, although this was not statistically significant. High effect sizes (r>0.5) were observed across most variables in the remaining groups. Notably, Group 1 and Group 3 consistently demonstrated statistically significant and large effect sizes across multiple outcome variables.

TABLE 1: Comparisons of demographic information of individuals

Variable	$\bar{X}$±SD	Test type	p value
Age (years)	53.33±7.072	Kruskal-Wallis H test	0.734
Group 1	51.50±8.031		
Group 2	52.70±6.533		
Group 3	55.00±7.180		
Group 4	54.10±7.078		
Height	163.23±7.058	Kruskal-Wallis H test	**0.033**
Group 1	163.90±7.752		
Group 2	159.70±4.692		
Group 3	161.90±6.757		
Group 4	167.40±7.245		
Weight	70.10±9.964	Fisher's F test	0.229
Group 1	71.10±10.148		
Group 2	72.80±12.848		
Group 3	64.50±6.042		
Group 4	72.00±8.807		
BMI	26.29±3.228	Fisher's F test	0.053
Group 1	26.48±3.630		
Group 2	28.40±3.783		
Group 3	24.62±1.993		
Group 4	25.65±2.266		

Group1: mus+mob+ex; Group 2: mus+ex; Group 3: mob+ex; Group 4: ex; mus: music, mob: mobilization, ex: exercises; p<0.05; SD: Standard deviation; BMI: Body mass index

Kruskal-Wallis tests revealed significant differences between groups for all outcome variables (p<0.05). Pairwise comparisons showed no significant differences between Group 1 and Group 3, or between Group 2 and Group 4 (Table 3). However, significant differences were found in most other group comparisons (p<0.05).

McNemar test results showed significant improvement in both Physical Role Difficulty and Emotional Role Difficulty post-treatment, with large effect sizes (Table 4). Several patients shifted from scores of 0 to 100 after intervention, indicating complete resolution of these limitations.

DISCUSSION

This study was meticulously designed to investigate the effects of music listening, integrated into the physiotherapy protocol, on the treatment process. The objective was to evaluate the potential impact of music on pain perception, ROM, functional capacity,

TABLE 2: Pre-treatment and post-treatment differences for groups according to variables

		Pre-treatment		Post-treatment			
Group	**Variable**	**n**	**$\bar{X}$±SD**	**n**	**$\bar{X}$±SD**	**p value**	**Effect size**
1	Resting pain	**10**	5.10±3.281	10	0.70±0.483	0.008	0.89
2			3.40±1.713		2.80±1.476	0.014	1.00
3			6.10±3.510		0.50±0.527	0.008	0.89
4			5.90±3.381		4.50±2.506	0.010	0.91
1	Activity pain	**10**	8.70±0.949	10	1.40±0.699	0.004	0.91
2			9.10±0.876		8.30±0.675	0.005	0.90
3			9.00±0.889		1.30±0.483	0.004	1.00
4			9.20±1.033		7.90±0.994	0.004	0.90
1	Night pain	**10**	8.40±1.713	10	0.50±0.707	0.005	0.92
2			7.00±2.906		6.30±2.541	0.008	0.89
3			9.20±0.789		0.60±0.699	0.004	1.00
4			8.50±1.841		7.30±1.703	0.010	0.90
1	Active flexion	**10**	71.50±8.835	10	171.0±3.162	0.005	0.91
2			72.50±3.536		86.50±6.258	0.005	0.90
3			69.50±6.852		173.0±9.487	0.004	0.89
4			75.00±5.270		83.00±7.149	0.007	0.90
1	Passive flexion	**10**	77.00±8.882	10	175.5±1.581	0.005	0.91
2			77.50±3.536		91.50±6.258	0.005	0.90
3			74.00±7.746		176.5±6.258	0.005	0.89
4			80.00±5.270		88.00±7.149	0.007	0.89
1	Active abduction	**10**	61.00±19.692	10	173.5±5.798	0.005	0.89
2			73.00±8.233		85.50±4.378	0.007	0.90
3			61.50±7.472		170.0±9.428	0.005	0.89
4			67.00±6.325		76.00±8.756	0.004	0.92
1	Passive abduction	**10**	67.00±17.981	10	176.5±3.375	0.005	0.89
2			78.00±8.233		89.00±3.162	0.007	0.90
3			66.00±8.433		174.0±6.992	0.005	0.89
4			72.00±6.325		81.00±8.756	0.004	0.92
1	Active external rotation	**10**	10.50±5.503	10	83.50±4.166	0.005	0.89
2			19.50±5.503		29.50±2.838	0.007	0.90
3			18.50±7.835		84.00±8.433	0.005	0.89
4			20.00±10.00		25.50±10.659	0.002	0.96
1	Passive external rotation	**10**	15.00±6.667	10	87.50±2.635	0.005	0.90
2			24.50±5.503		34.50±2.838	0.007	0.90
3			23.50±7.835		86.50±5.297	0.005	0.89
4			25.00±10.00		30.50±10.659	0.002	0.96
1	Active internal rotation	**10**	13.50±5.297	10	84.00±5.676	0.005	0.90
2			22.50±7.169		28.50±5.297	0.028	0.78
3			17.00±9.189		84.00±8.433	0.005	0.89
4			18.50±7.091		22.50±9.204	0.023	0.93
1	Passive internal rotation	**10**	18.50±5.297	10	88.00±4.830	0.004	0.91
2			27.50±7.169		33.50±5.297	0.028	0.78
3			22.00±9.189		86.50±5.297	0.005	0.89
4			23.50±7.091		27.50±9.204	0.023	0.93
1	Constant	**10**	20.10±7.724	10	73.20±14.482	0.005	0.89
2			19.90±6.488		26.00±6.616	0.005	0.89
3			14.20±7.829		76.40±6.835	0.005	0.89
4			18.60±4.142		22.30±5.638	0.005	0.94

TABLE 2: Pre-treatment and post-treatment differences for groups according to variables *(contunied)*							
		Pre-treatment		Post-treatment			
Group	Variable	n	X̄±SD	n	X̄±SD	p value	Effect size
1	DASH	**10**	94.93±23.454	10	23.46±16.122	0.005	0.89
2			50.31±13.956		49.54±13.403	0.865	0.06
3			76.59±17.249		6.84±9.145	0.005	0.89
4			71.21±12.612		67.54±12.990	0.011	0.89
1	Physical function	**10**	60.00±10.541	10	96.50±4.116	0.005	0.89
2			64.00±6.146		66.50±6.687	0.025	1.00
3			51.00±15.599		98.50±3.374	0.005	0.89
4			61.00±10.750		64.50±6.851	0.102	0.94
1	Energy vitality	**10**	31.50±11.068	10	69.00±21.960	0.005	0.89
2			46.00±25.364		50.50±26.505	0.041	0.91
3			28.00±14.944		72.50±10.607	0.005	0.89
4			34.24±26.032		32.62±20.970	1.000	0.00
1	Mental health	**10**	49.60±10.532	10	74.50±23.100	0.012	0.79
2			59.60±24.618		61.20±25.372	0.157	0.63
3			47.60±25.954		79.10±11.160	0.007	0.85
4			44.40±20.172		44.00±18.282	1.000	0.00
1	Social functioning	**10**	27.50±9.860	10	86.25±28.535	0.007	0.91
2			55.00±27.131		57.50±25.820	0.157	1.00
3			36.25±22.399		90.25±7.857	0.005	0.89
4			36.25±22.399		35.00±19.365	0.655	0.32
1	Pain	**10**	20.50±11.413	10	82.00±10.462	0.005	0.89
2			26.00±23.927		41.75±17.322	0.016	0.91
3			12.50±20.310		92.50±7.906	0.005	0.89
4			17.75±8.118		22.25±8.854	0.157	1.00
1	General health perception	**10**	39.00±7.746	10	79.50±11.891	0.005	0.89
2			47.50±25.847		53.75±27.870	0.223	0.55
3			32.50±20.582		83.00±14.757	0.005	0.89
4			45.50±14.804		51.25±19.194	0.180	0.95
1	General health change	**10**	25.00±20.412	10	97.50±7.906	0.004	0.91
2			27.50±14.191		40.00±12.910	0.025	1.00
3			27.50±32.167		95.00±10.541	0.007	0.90
4			27.50±7.906		35.00±12.910	0.083	1.00

Group1: mus+mob+ex; Group 2: mus+ex; Group 3: mob+ex; Group 4:ex; mus: music. mob: mobilization. ex: exercises; p<0.05; SD: Standard deviation;
DASH: Disabilities of the Arm, Shoulder, and Hand

TABLE 3: Multiple comparison results between groups for resting pain and other variables				
	Resting pain		All other variables	
Groups	p value	Effect size	p value	Effect size
Group 1-3	1.000	>0.81	p<0.05	>0.81
Group 2-3	0.002	>0.81	p<0.05	>0.81
Group 3-4	0.112	>0.81	p<0.05	>0.81
Group 1-2	0.012	>0.81	p<0.05	>0.81
Group 1-4	0.335	>0.81	p<0.0>	0.81
Group 2-4	1.000	>0.81	p<0.05	>0.81

Group1: mus+mob+ex; Group 2: mus+ex; Group 3: mob+ex;
Group 4:ex; mus: music. mob: mobilization. ex: exercises; p<0.05

and overall quality of life in individuals diagnosed with FS syndrome.

The findings of our study indicated significant improvements in all parameters within Group 1 and Group 3 ($p<0.05$), while Group 2 demonstrated similar outcomes in certain DASH and SF-36 parameters, and Group 4 exhibited similar results across all SF-36 parameters ($p>0.05$). Comparison between the groups revealed analogous results between Group 1 and Group 3, as well as between Group 2 and Group 4 ($p>0.05$). The superior outcomes in Group 1 and

TABLE 4: McNemar test results for physical role difficulty and emotional role difficulty variables

			Post-treatment			p value	Effect size
Physical role difficulty			**0**	**100**	Total		W_{MC}
	Pre-treatment	**0**	20	20	40	<0.001	0.96
		100	0	0	0		
		Total	20	20	40		
			Post-treatment			**p-value**	**Effect Size**
Emotional role difficulty			**0**	**100**	Total		W_{MC}
	Pre-treatment	**0**	20	20	40	<0.001	0.96
		100	0	0	0		
		Total	20	20	40		

W_{MC}: McNemar's test effect size; $p<0.05$

Group 3 may be attributed to differences in treatment adherence, baseline characteristics, or the combined effects of interventions. Future research should explore the underlying factors contributing to these differences.

Ryans et al., in their study investigating the efficacy of steroid treatment in FS patients, stated that 45 of the 78 patients they treated were women.[20] Hand et al. emphasized that female patients were more numerous than male patients in their study, which evaluated 223 FS patients.[21] In parallel with the literature, all the patients included in our study consisted of female patients.

Bridgman reported the age range for women as 39-77 in his study.[22] Among the patients included in our study, similar to the literature, the mean age of Group 1 was 51.50±8.03 years, the mean age of Group 2 was 52.70±6.53 years, the mean age of Group 3 was 55.00±7.18 years, and the mean age of Group 4 was 54.10±7.08 years.

Kingston, Curry et al., in their study examining 2,190 FS patients, stated that 27% of the patients were obese and 30% were overweight.[23] Among the patients participating in our study, the mean BMI of Group 1 was 26.48±3.63 kg/m^2, the mean of Group 2 was 28.40±3.78 kg/m^2, the mean of Group 3 was 24.62±1.99 kg/m^2, and the mean BMI of Group 4 was 25.65±2.

When we look at the dominant side efficiency, different results are seen. Vastamäki et al. found varying proportions of patients affected on the dominant side.[24] The present study, with 40 patients, also noted a majority of FS cases on the dominant side.

Mobilization techniques in FS are highly effective for increasing ROM.[25] Dueñas et al. demonstrated the effectiveness of manual therapy and a home exercise program on pain and functionality.[26] Our investigation demonstrated statistically significant enhancements in joint ROM across all subject cohorts before and after the designated therapeutic interventions, strongly supporting the efficacy of all four treatment regimens in fostering increased joint ROM.

Shaheen et al. reported pain reduction with US treatment in FS.[27] Al Shehriet al. compared Maitland mobilization and US treatment in FS, finding both effective for pain reduction, with mobilization being superior.[5] In our study, all 4 groups exhibited statistically significant pain reduction after 6 weeks of treatment compared to pre-treatment. Group 1 and Group 3 had larger effect sizes for VAS activity and VAS night scores, respectively. Our findings align with these studies, showcasing improvements in pain, functionality, and quality of life post-treatment.

Music has been reported to exert its effects through several neurophysiological mechanisms. It has been suggested that music modulates pain perception by influencing the limbic system and activating descending inhibitory pathways.[28] Music may enhance endorphin release, contributing to its analgesic effects.[4] Furthermore, listening to music has been shown to reduce stress and anxiety by regulating the autonomic nervous system, lowering heart rate, and reducing sympathetic nervous system activity.[29] These mechanisms could potentially explain why music intervention might have influenced the rehabilitation process in FS patients.

Şahbaz et al. investigated conventional and high-powered ultrasound effects on shoulder pain, ROM, and upper extremity functions in 20 FS patients, using joint ROM, VAS, and DASH. Both ultrasound techniques were effective with no significant difference.[30] Mehta et al. compared arthroscopic release outcomes in 21 diabetic and 21 non-diabetic FS patients using the modified constant score and ROM. The non-diabetic group had better outcomes.[31] In our study, DASH and modified constant scores were used for assessment. Significant improvement in modified constant scores was observed post-treatment in all groups, except for Group 2's DASH values. Modified constant scores showed substantial impact across all groups, while DASH had limited effectiveness, especially in Group 2.

A study conducted on 120 FS patients determined that quality of life decreased, and disability and severe pain rates increased. In patients evaluated using DASH, VAS, and SF-36 scales, it was found that mental components such as mood, emotional state, and mental well-being had a stronger influence on disability, pain, and quality of life than physical parameters.[32] The pre-treatment SF-36 results in our study support these findings. After treatment, statistically significant improvements were found in all SF-36 parameters in Group 1 and Group 3 and in some parameters in Group 2. However, in Group 4, no significant changes were observed in any parameter.

This study examined the effectiveness of music listening, commonly used in intensive care units to manage patients' pain and anxiety. Prior research has shown that auditory rhythm and music have specific therapeutic benefits. For instance, Calamassi et al. observed positive effects of music tuned to certain frequencies on sleep quality in spinal cord injury patients.[33] Similarly, Calamassi et al. reported reductions in anxiety and stress among coronavirus disease-2019 service nurses after music listening interventions.[34] However, no previous study has investigated the role of music listening in FS treatment.

While our study did not find statistically significant differences in pain reduction with listening to music, the literature suggests that music may have multifaceted benefits in different patient populations. Future research should explore the long-term effects of listening to music and its potential role in pain management and psychological well-being in FS patients.

LIMITATIONS

This study had several limitations. The small sample size (n=40), although supported by power analysis, may limit generalizability. All participants were female, preventing sex-based comparisons. Physiotherapists were not blinded, which could introduce bias. The 6-week duration only allowed assessment of short-term effects. Psychological factors such as stress, anxiety, and depression were not evaluated, despite their known influence on rehabilitation outcomes. Additionally, individual music preferences and placebo effects were not controlled, and patients were not fully isolated during treatment, which might have affected their focus during music listening. Finally, the use of goniometry for ROM assessment, while standard, has limited reliability.

CONCLUSION

This randomized trial demonstrated that integrating music listening with mobilization and exercise enhanced functional outcomes and quality of life in patients with FS. Although music alone did not significantly reduce pain, it appeared to support emotional well-being and treatment adherence. Groups receiving mobilization (with or without music) showed superior improvements in pain, ROM, and function. These findings support the use of music listening as a complementary intervention in FS rehabilitation. Further studies with larger and more diverse samples and longer follow-up periods are recommended to validate these results and explore the long-term benefits of music in physiotherapy.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Selma İşler, Seydi Ahmet Ağaoğlu;* ***Design:*** *Selma İşler, Burçin Öner;* ***Control/Supervision:*** *Selma İşler, Seydi Ahmet Ağaoğlu;* ***Data Collection and/or Processing:*** *Selma İşler;* ***Analysis and/or Interpretation:*** *Selma İşler, Burçin Öner;* ***Literature Review:*** *Selma İşler;* ***Writing the Article:*** *Selma İşler, Burçin Öner, Seydi Ahmet Ağaoğlu;* ***Critical Review:*** *Selma İşler, Burçin Öner, Seydi Ahmet Ağaoğlu;* ***References and Fundings:*** *Selma İşler, Burçin Öner, Seydi Ahmet Ağaoğlu;* ***Materials:*** *Selma İşler.*

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