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ORIGINAL ARTICLE

Effectiveness of motor imagery training on functionality and quality of life in chronic neck pain: a randomized controlled trial

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Purpose: The present study aimed to investigate the effectiveness of motor imagery training on pain, disability, motor imagery, and quality of life in young adults with chronic non-specific neck pain.

Methods: Forty young adults with non-specific neck pain were randomly allocated into exercise groups (N=20) and motor imagery training+ exercise groups (N=20). Patient assessment form, Visual Analog Scale (pain), Neck Disability Index (disability level), Motor Imagery Questionnaire-3 (motor imagery ability), and Short Form-36 Health Survey (SF-36) (quality of life) were used for evaluation before and after the treatment. The exercise program included dynamic isometric neck exercises and deep neck muscle training exercises. The exercise program was executed for 5 days a week for 4 weeks for both groups. For motor imagery training+exercise groups, motor imagery training was applied in addition to exercise.

Results: Pain and disability values significantly decreased for both groups after the treatment ($p<0.05$). For motor imagery ability, kinesthetic and internal visual imagery increased for both groups after the treatment ($p<0.05$). Physical function, social function, and mental health sub-parameters of Short Form-36 Health Survey were increased for motor imagery training+exercise groups after the treatment ($p<0.05$). However, all assessment values showed no statistically significant difference between the groups ($p>0.05$).

Conclusion: The effects of the exercise program were taken into account; motor imagery training did not seem to add any additional contribution to the treatment of non-specific chronic neck pain in young adults.

Keywords: Imagery, Neck Pain, Quality of life.

Kronik boyun ağrısında motor imgeleme eğitiminin fonksiyonellik ve yaşam kalitesi üzerine etkisi: randomize kontrollü çalışma

Amaç: Amacımız, non-spesifik kronik boyun ağrılı genç yetişkinlerde motor imgeleme eğitiminin ağrı, özürlülük, motor imgeleme ve yaşam kalitesi üzerine etkisini incelemekti.

Yöntem: Non-spesifik boyun ağrısı olan 40 genç yetişkin, randomize olarak egzersiz grubu (N=20) ve motor imgeleme eğitimi+egzersiz grubu (N=20) olarak ikiye ayrıldı. Değerlendirme için; hasta bilgi formu, Vizüel Analog Skalası (ağrı), Boyun Özür Göstergesi (özür düzeyi), Hareket İmgeleme Anketi-3 (motor imgeleme yeteneği) ve Kısa Form-36 (KF-36) yaşam kalitesi formu (yaşam kalitesi) tedaviden önce ve sonra kullanıldı. Egzersiz programı, boyun dinamik izometrik egzersizleri ve derin servikal kas eğitimi egzersizlerini içermekteydi. Egzersiz programı iki gruba da haftada 5 gün 4 hafta uygulandı.Motor imgeleme eğitimi+egzersiz grubunda,egzersizlere ek olarak motor imgeleme eğitimi uygulandı.

Bulgular: Tedaviden sonra her iki grupta ağrı ve özür düzeyleri azaldı ($p<0,05$).Hareket imgeleme yeteneği açısından, kinestetik ve iç görsel imgeleme düzeyi her iki grupta tedaviden sonra arttı ($p<0,05$). Tedaviden sonra motor imgeleme eğitimi+egzersiz grubunda, yaşam kalitesi alt parametrelerinden fiziksel fonksiyon, sosyal fonksiyon ve mental sağlık arttı ($p<0,05$). Gruplar arasında yapılan tüm istatistiksel değerlendirmelerde fark bulunmadı ($p>0,05$).

Tartışma: Egzersiz eğitiminin etkileri göz önüne alındığında, motor imgeleme eğitiminin non-spesifik kronik boyun ağrılı genç yetişkin bireylerde tedaviye ek herhangi bir katkısının olmadığı görülmektedir.

Anahtar kelimeler: İmgeleme, Boyun ağrısı, Yaşam kalitesi.

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Neck pain is one of the most common musculoskeletal problems in young adults.[1] If not treated, it becomes chronic in later ages.[2] In the literature, exercise practices are approved for treating chronic neck pain due to their positive impacts on the pain and quality-of-life parameters.[3,4] The number of studies evaluating the effect of motor imagery training on musculoskeletal problems such as neck, shoulder and low back pain has increased in recent years.[5-7]

Motor imagery is the mental realization of motion before any motion occurs. It has two categories: kinesthetic and visual imagery. Kinesthetic imagery is the situation of feeling a motion. Visual imagery has two types: internal visual and external visual. In the internal visual imagery, the motion is visualized within the body by seeing feet and arms. The external visual imagery is that one sees himself/herself from outside.[8,9] Studies were contradictory in terms of showing whether visual or kinesthetic imaging is more effective. However, it was also reported that clinical studies including both might be more effective.[8] The positive effects of motor imagery training on some parameters such as pain and disability in neck and low back pain and knee pain have been reported in recent years.[5,7,10] The cortical organization in the adult brain varies with chronic pain.[11-13] Reorganization of sensorial and motor cortical areas is required for motor learning and healing.[14] Functional magnetic resonance imaging (fMRI) studies showed that motor imagery training activated similar areas with normal motor motion. It was reported that motor imagery training applied with exercise produced cortical reorganization in patients with chronic pain.[15,16]

Therefore, this study was conducted to investigate the effect of motor imagery training in addition to exercise on pain, disability, motor imagery, and quality of life in young adults with chronic neck pain.

METHODS

This study was a randomized single-blind clinical trial. The assessment and treatment were performed by two different physiotherapists. The physiotherapist who made the assessments was blind in terms of knowing groups of the patients. The patients were informed in advance not to notify the physiotherapist who made the assessment.

Participants

This study was conducted with the students aged between 18 and 22 years of age and studying in Manisa Celal Bayar University. Patients with a non-specific neck pain for at least 3 months were included in the study after being examined by a specialist physician. The exclusion criteria in the study were as follows: patients treated for neck pain in the last 6 months; patients having speech and understanding problems; patients undergoing a surgery in the neck region; patients having a sensory loss; patients diagnosed with an orthopedic or neurological disease; patients having a trauma history; patients diagnosed with/treated for cancer or osteoporosis; and patients having a systemic disease and drug use history.

An approval was obtained from the Dokuz Eylül University Ethics Board for this study. Also, the patients were informed about the study. The study was started after getting patients' approval for participation.

Randomization

The patients were randomized by the sealed-envelope selection method. They were separated into two groups: exercise groups and motor imagery training+exercise groups (Figure 1: Study consort chart).

Assessment

The study assessment was performed using a patient assessment form, Visual Analog Scale (VAS), Neck Disability Index, Motor Imagery Questionnaire-3, and Short-Form-36 Health Survey (SF-36). Measurements were applied before and after the treatment for both groups.

The patient assessment form included some personal information of the patients, such as age, body height, and body weight.

Pain intensity was assessed on a 10-cm line using VAS: 0 defined no pain, and 10 defined an intolerable pain.[17]

The Neck Disability Index was a 10-question survey. The Neck Disability Index assesses the level of disability perceived by patients in their daily lives. The validity and reliability of the Turkish version of this test were studied by Aslan et al.[18] Each issue had six answer options between 0 (no disability) and 5 (completely disabled). The score was calculated with percentage within the range of 0-100. The disability scores of the participants were calculated by dividing the total score by the number of questions answered and multiplied by a hundred.

The Motor Imagery Questionnaire-3 was used to assess the imaging influence of a person. The validity and reliability of the Turkish version of the Motor Imagery Questionnaire-3 were evaluated by Dilek et al.[19] The Motor Imagery Questionnaire-3 had three subscales: internal visual imagery, external visual imagery, and kinesthetic imagery. The score was calculated separately for each subscale. An increase in the score meant an increase in the level of imagination of patients.

The Short-Form-36 Health Survey (SF-36) was a questionnaire validated by Kocyigit et al.[20] It determined the level of life quality. SF-36 had a total of eight subcomponents: physical function, physical role limitation, pain, general perception of health, vitality (energy), social function, emotional role limitation, and mental health. The answers from the participants were scored between 0 and 100. A high score indicated a good quality of life.

Exercise schedule

The patients in both groups exercised for 45 min, 5 days a week for 4 weeks, under the supervision of a physiotherapist, all the exercises were done 10-12 times. The number of exercises increased every week. The color of the elastic band in dynamic isometric training was determined specific to each participant. We wanted patients to complete 10 to 15 repetitions per set with elastic band and to rate their perception of exertion with Borg Scale. Between 12 and 14 level of Borg Scale were aimed for appropriate intensity level.

The exercise sessions were organized into groups of eight people. The exercise program included craniocervical flexion and craniocervical extensor exercises on a bed, and cervical dynamic isometric exercises with an elastic band in the sitting position in the first 2 weeks. In the third and fourth weeks, cervical dynamic isometric exercises in standing position were added to this exercise program. The same exercises were applied in both groups.

Motor imagery training

The patients were informed about the program. The motor imagery training was given for a maximum 15 min, 5 days a week for 4 weeks after the exercise program was over. A different motor imagery training component was implemented each week:

Week 1: Kinesthetic imagery.

Week 2: Visual imagery.

Week 3: Action observation together with motor imagery.

Week 4: Exercises in front of a mirror.

The motor imagery training was performed in a quiet environment. The patients were asked to close their eyes during imagery and concentrate on the training.

During kinesthetic imagery, the participants were asked to feel their body parts without any body motion. During visual imagery, the participants were asked to perform a visual presentation of the motion without any body motion. A video record was prepared with the exercises for the action observation, and this record was shown to the participants. A single-type command was given to the participants by means of these obtained records.

Statistical analysis

Data were statistically analyzed using the SPSS version 22.0 program (IBM SPSS Statistics version 22 for Windows, USA). The multivariate normal distribution suitability of the groups was assessed using the PAST program with Mardia's multivariate normality test. The univariate normal distribution suitability for groups and times that did not satisfy multivariable normality was tested using the Shapiro-Wilk normality test. The descriptive statistical data were expressed as mean and standard deviation in the case when the parametric assumptions were satisfied. If these assumptions were not satisfied, the statistical data were expressed as median (minimum–maximum) in the table. The descriptive statistics for the categorical variables were given as numbers (%).

If the parametric test assumptions were satisfied, it was important to consider whether the changes made by the groups on the measurements over time were meaningful, whether the time effect on the measurements was meaningful, and whether the changes in measurements in groups over time were similar (time and group interaction). These were analyzed using Two-way Analysis of Variance (ANOVA) with repeated measures of repetition on a single factor. The level of significance was detected as α=0.05.

Student t test was used to detect the difference between groups when the parametric test assumptions were not satisfied but univariate normality was satisfied. In the cases where normality was not satisfied either, the Mann–Whitney U test was used. The paired t test was used to detect the difference between time intervals when the univariate normality assumption was satisfied. When normality was not satisfied either, the data were analyzed using the Wilcoxon test. The level of significance was calculated according to α^* with Bonferroni correction, which was $\alpha^* = 0.0125$.

RESULTS

The exercise group consisted of 2 (10%) males and 18 (90%) females. The motor imagery training+exercise group consisted of 5 (25%) males and 15 (75%) females. No difference was found between groups in terms of gender (p=0.407). Also, no difference was observed in terms of the mean age, body height, and body weight (p=0.320, p=0.861, p=0.269) (Table 1).

Pain

The pain intensity decreased significantly in both groups after treatment ($p<0.001$). However, no significant difference was noted between groups (p=0.369) (Table 2).

Disability

In general, the change in disability did not differ between groups (p=0.125). The change in disability decreased over time for both groups ($p<0.001$). The change in disability did not differ between groups (p=0.608) (interaction time × group) (Table 3).

Motor imagery ability

The changes in the internal visual imagery and kinesthetic imagery was different between groups (p=0.007 and p=0.021, respectively). The change in the internal visual and kinesthetic imageries increased over time in general ($p<0.001$ and p=0.010, respectively). The change in visual and kinesthetic imagery over time does not differ between groups (p=0.541, p=0.862) (interaction time × group) (Table 3). The intragroup and intergroup assessment of external visual imagery abilities did not differ before and after the treatment (Table 2).

Quality of life

The change in pain and general health sub-parameters of SF-36 did not differ between groups (p=0.068 and p=0.115, respectively). The overall change in perception of pain and general health increased over time ($p<0.001$). The overall change in perception of pain and general health over time did not differ between groups (p=0.401 and p=0.612, respectively) (interaction time × group) (Table 4). In the quality-of-life sub-parameters, a significant increase over time was noted in the motor imagery training+exercise groups for the physical function, social function, and mental health sub-parameters (Table 5).

DISCUSSION

This study aimed to determine whether motor imagery training in addition to exercise, applied to young adults with a chronic neck pain, was effective in reducing pain intensity and disability level and enhancing imagery ability and quality of life.

The results of pain assessments indicated a decrease in pain intensity in both groups after treatment. However, no statistically significant difference was found in terms of pain between the groups. Hoyek et al.[6]applied 10 sessions of motor imagery training on patients with impingement and observed a decrease in pain severity.

In another study by Lebon et al.,[21] patients who underwent surgery due to anterior cruciate ligament injuries underwent 34 sessions of motor imagery training. The pain severity in patients was found to be reduced. The two aforementioned studies compared the effectiveness of motor imagery training and conventional physiotherapy.[6,21] Moreover, different imagery trainings were used in these studies. In the present study, 20 sessions of motor imagery training in addition to exercise were applied.

In the other studies, the motor imagery training applied together with an exercise program reduced the severity of pain in patients with low back pain.[7,22] In the present study, motor imagery training was applied

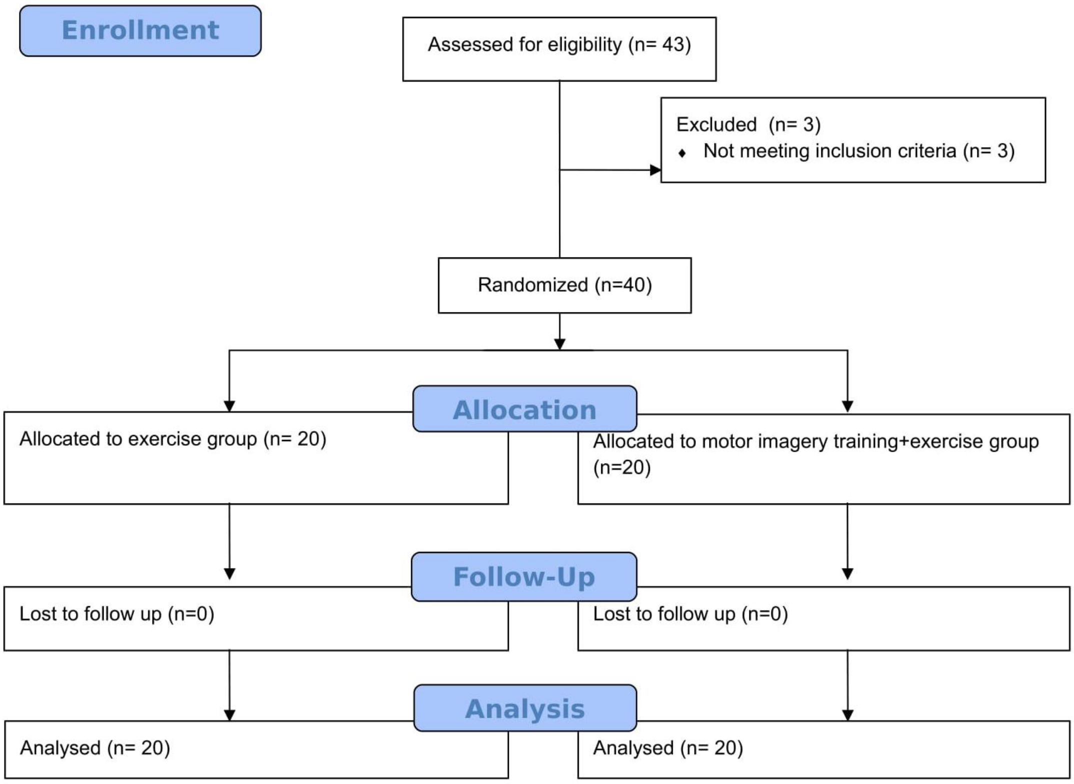

Figure 1. CONSORT flow diagram of the study.

Table 1. Demographic and physical characteristics of the patients.

	Exercise Group Mean±SD	MI Training+Exercise Group Mean±SD	p
Age (years)	19.70±1.17	20.10±1.33	0.320
Height (cm)	165.90±6.76	166.40±9.21	0.861
Body weight (kg)	59.40±8.43	63.40±13.47	0.269

MI: Motor Imagery.

Table 2. Intra-group and inter-group comparisons of pain severity and external visual imagery.

		Before Median (Min-Max)	After Median (Min-Max)	p_1
Pain severity	Exercise Group	4.35 (0.9-7.2)	1.0 (0.0-4.5)	<0.001*
	MI Training+Exercise Group	4.55 (1.8-7.7)	1.5 (0.0-5.9)	<0.001*
	p_2	0.659	0.369	
MIQ-3 External Visual Imagery	Exercise Group	5.88 (3.75-7.0)	6.00 (4.5-7.0)	0.387
	MI Training+Exercise Group	6.38 (4.25-7.0)	6.38 (4.0-7.0)	0.177
	p_2	0.102	0.086	

MI: Motor Imagery. Movement Imagery Questionnaire-3: MIQ-3. p_1: Wilcoxon test, p_2: Mann-Whitney U test. * Bonferroni correction was applied α * = 0.0125.

Table 3. Intra-group and inter-group comparison of Internal visual imagery, Kinesthetic imagery, Neck Disability Index.

		Before Mean±SD	After Mean±SD	p
Internal visual imagery	Exercise Group	5.20±0.79	5.70±0.69	<0.001
	MI Training+Exercise Group	5.80±0.76	6.20±0.62	<0.001
			Interaction p	0.541
Kinesthetic imagery	Exercise Group	5.30±0.98	5.70±0.77	0.010
	MI Training+Exercise Group	5.80±0.77	6.20±0.69	0.010
			Interaction p	0.862
Neck Disability Index	Exercise Group	%20.50±7.72	%7.98±5.51	<0.001
	MI Training+Exercise Group	%24.20±9.56	%10.40±5.02	<0.001
			Interaction p	0.608

MI: Motor Imagery. p values: Two-Way ANOVA with repeated measures in one factor.

Table 4. Intra-group and inter-group comparisons of SF-36 pain and general health subparameters scores.

		Before Mean±SD	After Mean±SD	p
Pain	Exercise Group	63.50±15.89	80.80±9.30	<0.001
	MI Training+Exercise Group	59.10±16.56	71.90±13.35	<0.001
			Interaction p	0.401
General health	Exercise Group	63.70±18.10	72.85±13.49	<0.001
	MI Training+Exercise Group	54.50±20.24	65.45±16.29	<0.001
			Interaction p	0.612

MI: Motor Imagery. p values: Two-Way ANOVA with repeated measures in one factor.

Table 5. Intra-group and inter-group comparisons of SF-36 subparameters scores.

		Before Median (Min-Max)	After Median (Min-Max)	p_1
Role Physical	Exercise Group	75 (0-100)	100 (50-100)	0.024
	MI Training +Exercise Group	75 (0-100)	100 (0-100)	0.035
	p_2	0.640	0.529	
Social Function	Exercise Group	75 (50-100)	87.5 (62.5-100)	0.050
	MI Training +Exercise Group	75 (0-100)	87.5 (50-100)	0.001*
	p_2	0.174	0.820	
Role Emotional	Exercise Group	66.67 (0-100)	100 (0-100)	0.163
	MI Training +Exercise Group	66.67 (0-100)	100 (0-100)	0.0128
	p_2	0.758	0.968	
Mental Health	Exercise Group	66 (36-84)	70 (56-92)	0.013
	MI Training +Exercise Group	68 (16-88)	76 (28-92)	<0.001*
	p_2	0.841	0.277	
		Mean±SD	Mean±SD	p_3
Physical Function	Exercise Group	88.25±9.64	92.50±7.52	0.094
	MI Training +Exercise Group	86.50±10.89	92.75±8.81	0.0123*
	p_4	0.594	0.924	
Vitality	Exercise Group	60.25±16.26	69.00±12.73	0.007*
	MI Training +Exercise Group	55.50±21.45	70.00±17.17	<0.001*
	p_4	0.435	0.835	

MI: Motor Imagery. p_1: Wilcoxon test, p_2: Mann-Whitney U test, p_3: Paired Samples t test, p_4: Student's t test.
* Bonferroni correction was applied α * = 0.0125.

together with an exercise program. In the literature, studies on motor imagery training were usually included as case studies. However, the present study was not a case study and completed with 40 patients. In addition, an exercise program was applied to both groups in our study, although no additional treatment was given to the control group in the other study. There is moderate evidence of benefit on pain reduction in neck disorders for exercises.[23] This could be exercise effects for both groups.

Muscle strength and muscle endurance decrease due to chronic neck pain, resulting in more severe pain in the vicious circle. Moreover, disability is increased by the pain. The number of patients was small and no treatment was given to the control group in the study conducted by Paloucci.[7]However, the study reported that motor imagery training reduced the level of disability in patients with low back pain. In the present study, exercise training was applied to both groups. Joint and muscle receptors are activated and corticomotor excitability is increased by motor imagery training.[21] Further, studies in the literature indicated that the level of disability and pain could be reduced both motor imagery training and exercise program.[6,24] The first assessment data in the present study showed that the percentage of disability in the motor imagery training+exercise group was higher. The scores showed a decrease of 13.8 and 12.52 in the motor imagery training+exercise group, respectively. The present study demonstrated that motor imagery training in addition to exercise may be alternative treatment method for decreasing disability level.

The results of the motor imagery training indicated that the ability of kinesthetic and visual imagery increased positively over time. However, no statistically significant difference was observed between the two groups. The cortical changes in patients with phantom pain, fibromyalgia, low back pain, neck pain were different from those in healthy individuals.[3,21,25,26] Moreover, patients with chronic back pain had reduced imagery ability compared with those who did not have.[7,27] In the present study, a questionnaire with scores between 0 and 7 was used to assess imagery ability. The survey results showed that only exercise training and motor imagery training+exercise training were methods that increased the imagery ability.

Health-related quality of life increased in both groups after treatment. The decrease in pain severity also changed the pain perception. Further, the motor imagery training and exercise affected the cognitive level with the positive change in social functioning and mental health parameters. Guillot and Collet[28] pointed out positive effects of motor imagery training on psychological components such as motivation, anxiety, and self-esteem. Although motor imagery training had positive effects on changes in physical and mental components, no studies evaluating the quality of life were found in the literature. This novel study evaluated the quality of life in patients with neck pain who were given motor imagery training and exercise.

Limitations

One of the limitations of the present study was the gender factor. Although the effect of gender was noted in the literature in terms of cortical reorganization, no results related to this factor could be reported in the present study. Hence, gender factor should be taken into consideration while planning further studies. The long-term effects of different exercise programs related to motor imagery training need further investigation. Recent studies indicated that changes in cortical reorganization could occur with motor imagery training. However, the effects of these factors were not explored in the present study. Functional MRI studies are needed in this regard.

Conclusion

This novel study assessed the effect of motor imagery training and exercise training on pain, disability, imagery ability and quality of life in patients with chronic neck pain. Moreover, it was the only study that used kinesthetic and visual imagery programs together in patients with neck pain. However, the motor imagery training in addition to exercise training did not provide any contribution to neck pain rehabilitation.

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