Turk J Phys Med Rehab 2024;70(1):98-104
DOI: 10.5606/tftrd.2024.12716
Available online at www.turkishjournalpmr.com

Original Article

Efficacy of trigger point injection therapy in noncardiac chest pain: A randomized controlled trial

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ABSTRACT

Objectives: This study aimed to compare the effects of trigger point injections and stretching exercises in patients with noncardiac chest pain (NCCP) associated with myofascial pain syndrome.

Patients and methods: This prospective randomized controlled trial included 50 patients with noncardiac chest pain and trigger points in the pectoralis muscles between October 2019 and June 2020. The patients were randomly assigned to receive trigger point injections into the pectoralis muscles and exercise (n=25; 15 males, 10 females; mean age: 42.8±9.2 years; range, 25 to 57 years) or only perform exercise (n=25; 11 males, 14 females; mean age: 41.8±11.2 years; range, 18 to 60 years). The primary outcome was pain intensity at the first month and three months after the first treatment session, measured using the Visual Analog Scale from 0 to 100. The secondary outcome was the Nottingham Health Profile score.

Results: Treatment with stretching exercises and trigger point injection resulted in significant pain reduction compared to stretching exercises alone, and the reduction was persistent at the three-month follow-up ($p<0.001$). A between-group comparison showed no significant difference in the Nottingham Health Profile ($p=0.522$). Complications related to the procedure or severe adverse events attributable to treatment were not reported.

Conclusion: Trigger point injection combined with stretching exercises is an efficient treatment for noncardiac chest pain related to myofascial pain syndrome compared to exercise treatment alone.

Keywords: Myofascial trigger point injection, non-cardiac chest pain, stretching exercises.

Chest pain is an important health concern worldwide. Although chest pain accounts for approximately 10% of noninjury-related visits to the emergency department, less than half of these patients receive a definite diagnosis of cardiac chest pain.[1] The rest are usually discharged without a definitive diagnosis, and their pain is labeled as noncardiac chest pain (NCCP).[2] The prevalence of NCCP may reach 70%. It may present at all levels of medical care. There is an unmet need for diagnostic approaches and therapeutic options in these patients. There are many clinical studies on the diagnosis and classification of NCCP, with lack of information on patient management and treatment.[3,4] Patients with NCCP continue to suffer from pain, which is associated with anxiety, fear of undiagnosed heart disease, loss of working capacity, and hospital readmissions.[5,6]

The chest wall contains various bone and soft tissue structures. Therefore, it is difficult to pinpoint the exact cause of the pain. Physicians often try to identify the specific causes of NCCP. Pain is apparent in acute trauma or injuries such as rib fracture or contusion and strains in the pectoral or intercostal

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Received: March 30, 2023 **Accepted:** August 12, 2023 **Published online:** February 01 , 2024

Cite this article as: Şengül M, Tekeli Şengül S. Efficacy of trigger point injection therapy in noncardiac chest pain: A randomized controlled trial. Turk J Phys Med Rehab 2024;70(1):98-104. doi: 10.5606/tftrd.2024.12716.

muscles.[7] In other cases, identifying the source of NCCP is difficult in the absence of standardized criteria for diagnosis and gold standard diagnostic tests.

Myofascial pain syndrome (MPS) is a common cause of chest pain, associated with tender points called trigger points in muscles or surrounding connective tissues, presenting with pain, muscle spasms, limitation of range of motion, sensitivity, and weakness.[8] Symptoms generally occur in parts of the body distant from the trigger point.[9] Myofascial pain may worsen by muscle overuse, cold, anxiety, and postural imbalance. The somatic presentation of pectoralis muscle trigger points, as described by Simons et al.,[10] is similar to cardiac angina and thus may be considered a differential diagnosis for chest pain.[11-13]

Inactivation of trigger points represents a challenge in the treatment of MPS. Various physical therapy modalities have been suggested for MPS to inactivate trigger points, including exercise.[14] However, these therapeutic modalities should be compared to determine their priorities and superiorities. In this study, we aimed to evaluate the effectiveness of trigger point injection plus exercise versus exercise alone in patients with NCCP.

PATIENTS AND METHODS

This prospective randomized controlled trial was conducted between October 2019 and June 2020 in the Ankara Gaziler Physical Medicine and Rehabilitation Training and Research Hospital. Sixty-three NCCP patients were assessed for inclusion in the study. Three patients refused to participate in the study, and five failed to meet the inclusion criteria. Furthermore, five patients were unable to complete the study. Thus, 50 consecutive patients from the outpatient clinic were included in the study. Twenty-five patients (15 males, 10 females; mean age: 42.8±9.2 years; range, 25 to 57 years) were in the injection group and 25 patients (11 males, 14 females; mean age: 41.8±11.2 years; range, 18 to 60 years) were in the exercise group.

Myofascial pain syndrome was diagnosed based on the diagnostic criteria of Simons et al.[10] Among the patients who presented to our cardiology outpatient clinic with a complaint of chest pain, those with at least one trigger point or one taut band on the pectoralis muscles, as confirmed by normal electrocardiography, echocardiography, and treadmill exercise testing, were included. Patients diagnosed with a cardiac disease, fibromyalgia, inflammatory rheumatic disease, cervical radiculopathy, myelopathy, diabetes mellitus, pulmonary-thyroid-gastrointestinal, and hepatobiliary diseases were excluded. Other exclusion criteria were trigger point injection treatment for a diagnosis of MPS in the past six months, neck and shoulder surgery in the past year, allergy to local anesthesia, bleeding disorders, use of anticoagulant drugs, pregnancy, and breastfeeding.

Pain level of all patients was evaluated before treatment and at the first and third months after treatment using the Visual Analog Scale (VAS), and the quality of life was evaluated using the Nottingham Health Profile (NHP). On the VAS, 0 mm represented "no pain at all," whereas 100 mm indicated "worst pain imaginable."

Each patient underwent physical examination as well as collection of detailed information on personal history, family history, smoking habits, and medications used. Routine tests and examinations (complete blood count, biochemistry, lipid profile, electrocardiography, echocardiography, and treadmill exercise testing) were performed for patients presenting to our cardiology outpatient clinic with chest pain.

The patients were randomly divided into groups by the sealed envelope method. The injection group received trigger point injections with local anesthetic (lidocaine 1%) into the pectoralis muscles once a week for three weeks and a standard stretching home exercise program for anterior chest muscles, particularly the pectoralis muscles, for 20 min three times a week for a total of three week. The exercise group was only given the same standard stretching home exercise program provided for the injection group. Patients in the exercise group were asked to return to the outpatient clinic once a week for three weeks to monitor their compliance. Patients in both groups did not receive any analgesics during the treatment period. Injections were applied to the trigger points and taut bands under aseptic conditions (Figure 1). The solution was a mixture of 2.5 mL of saline and 2.5 mL of 2% lidocaine. Taut bands were identified by palpation. The same researcher performed all the procedures.

Statistical analysis

A total of 60 patients (30 in the exercise group and 30 in the injection group) were needed to detect a VAS within-between interaction effect of 0.25 (Cohen's f), with 0.95 power at the 0.05 significance level (number of measurements: 3; correlation among measurements: 0.3).

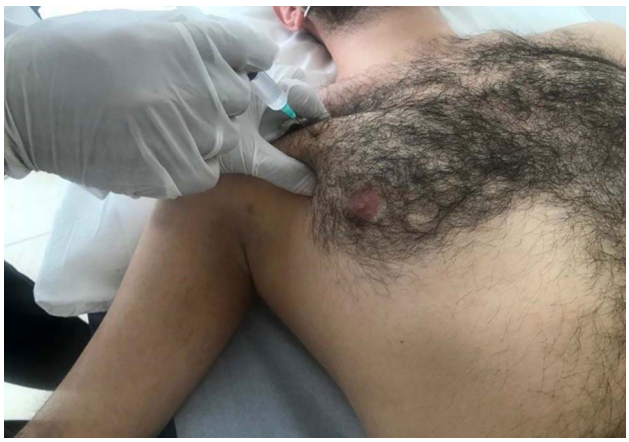

Figure 1. Trigger point injection to the pectoralis major muscle.

Statistical analysis was performed using the SPSS version 15.0 software (SPSS Inc., Chicago, IL, USA) and RStudio version 2022.02.1 (Build 461© 2009-2022 RStudio, Inc., Boston, MA, USA). The normality and multivariate normality of the variables were analyzed using visual and analytical methods (Shapiro-Wilk and Mardia's tests). Descriptive statistics were presented as mean ± standard deviation (SD) and median (min-max) for numerical variables and as frequency (percentage) for categorical variables. Comparisons between groups were made using the Pearson chi-square test and the independent samples t-test or the Mann-Whitney U test for categorical and numerical variables, respectively. A robust rank based method for longitudinal data (F1-LD-F1 design) was used to test the effect of group, time, and group-time (Gxt) interaction effect on NHP and VAS levels.[15] Relative treatment effect values with their 95% confidence intervals were used to make inferences. Relative treatment effect is the probability that a randomly selected subject from the treatment group has an observation value as large/larger than a randomly selected subject from the whole dataset, and overlapping confidence intervals indicate that there is no statistically significant difference in the outcome measure between groups or time points being compared. The nparLD (Nonparametric Analysis of Longitudinal Data in Factorial Experiments) package for R[16] was used to implement the F1-LD-F1 design, and due to small sample size, analysis of variance results were presented. A p-value <0.05 was considered statistically significant.

RESULTS

A flowchart of the study is shown in Figure 2. Both groups had similar baseline characteristics (Table 1). No adverse effects were reported during the treatment and follow-up. Both treatments were well tolerated. The demographic characteristics are provided in Table 1. Age, sex, body mass index, and duration of pain were similar in both groups. The median duration of pain history was six (range, 2 to 13) months versus six (range, 3 to 12) months in the injection and exercise groups, respectively.

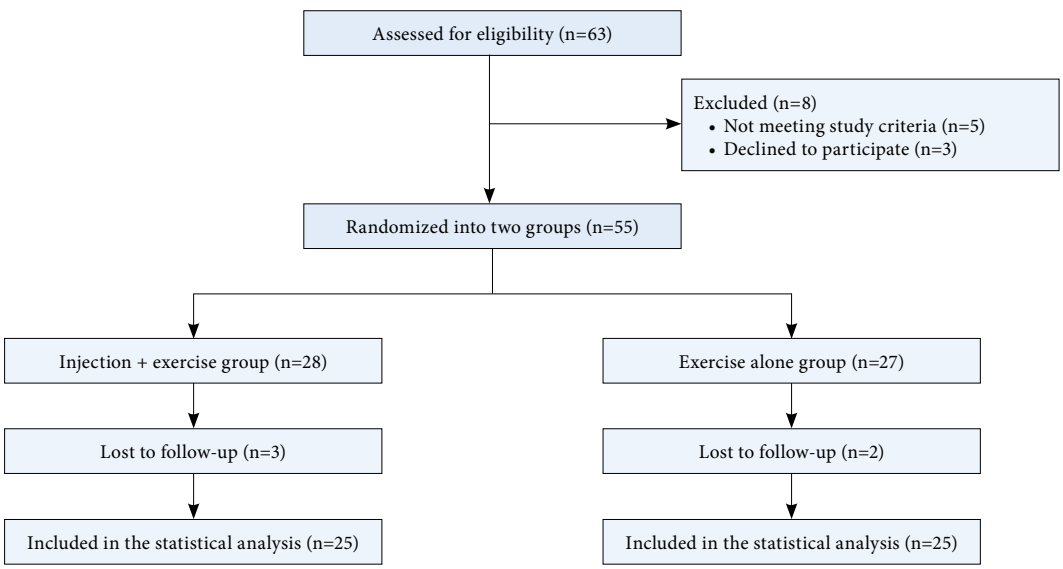

Figure 2. Flowchart of the study.

The descriptive statistics of the study, outcome measures of the groups at baseline, and follow-up periods are presented in Table 2. There was a significant improvement in VAS levels at baseline, Week 4, and Week 12 in both groups (p<0.001). The group and Gxt interaction effects on VAS levels were found to be statistically significant (both p<0.001, Figure 3).

TABLE 1
Baseline characteristics

	Injection + Exercise (n=25)					Exercise only (n=25)					
	n	%	Mean±SD	Median	Range	n	%	Mean±SD	Median	Range	*p*
Age (year)			42.8 ± 9.2					41.8 ± 11.2			0.724[a]
Sex											0.774[b]
Female	15	60				11	44				
Male	10	40				14	56				
BMI (kg/m^2)			28.04 ± 5.04					26.84 ± 3.10			0.317[a]
Duration of pain (month)				6	2-13				6	3-12	0.797[c]
Smoking	11	44				8	32				0.336[b]

SD: Standard deviation; BMI: Body mass index; a: Independent Samples t-test; b: Pearson Chi-square test; c: Mann-Whitney U test.

TABLE 2
Study outcome data

	Baseline			4-Weeks			12-Weeks		
	Mean±SD	Median	Min-Max	Mean±SD	Median	Min-Max	Mean±SD	Median	Min-Max
VAS									
Exercise only	63.6±9.9	60	50-90	35.2±11.2	40	10-60	32.0±11.9	30	10-50
Injection and exercise	67.6±8.8	70	50-80	18.0±10.4	20	0-30	12.8±11.7	10	0-40
NHP									
Exercise only	224.8±115.0	205.2	62.5-480.2	141.5±81.3	103.3	25.0-331.9	140.5±81.2	112.4	25.0-323.0
Injection and exercise	278.8±128.8	270.2	75.0-523.8	112.8±88.5	101.9	0-330.5	97.9±91.7	87.2	0-355.5

SD: Standard deviation; VAS: Visual Analog Scale; NHP: Nottingham health profile.

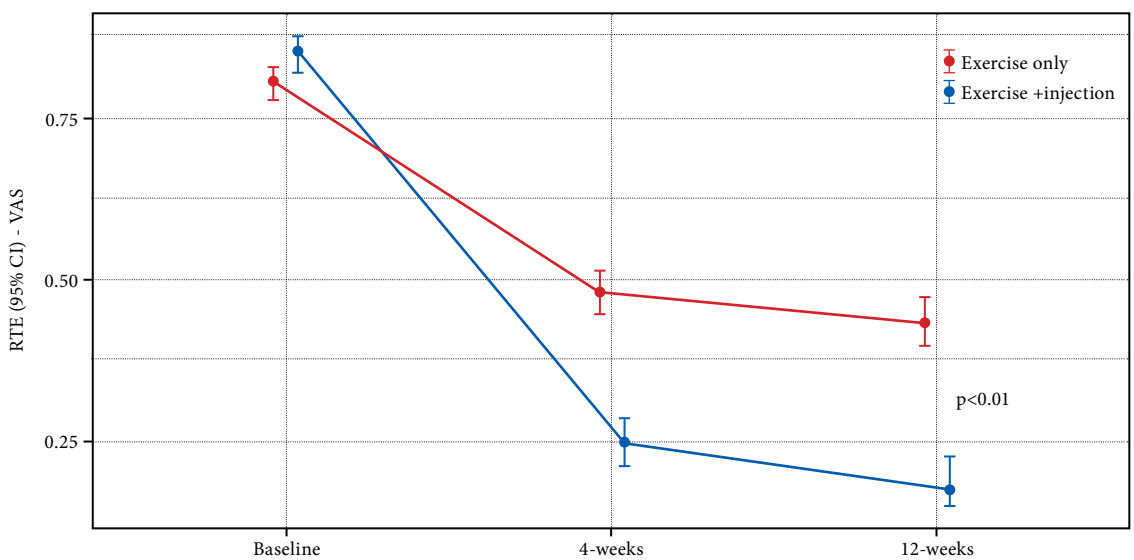

Figure 3. VAS levels improvement with time in injection+exercise and exercise alone groups.
RTE: Relative treatment effect; VAS: Visual analog scale; CI: Confidence interval.

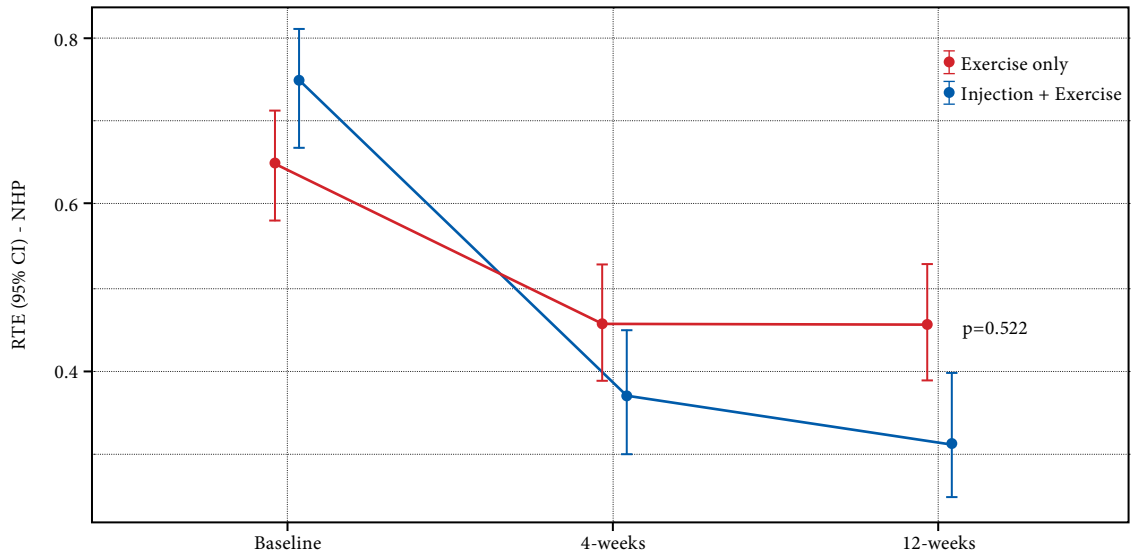

Figure 4. NHP levels improvement with time in injection and exercise alone groups.
RTE: Relative treatment effect; NHP: Nothingham health profile; CI: Confidence interval.

Time had a statistically significant improvement effect on NHP ($p<0.001$), and the Gxt interaction effect was also statically significant ($p<0.001$). However, the group effect had no statistically significant impact on NHP scores ($p=0.522$, Figure 4).

DISCUSSION

Although musculoskeletal pain is a common cause of chest pain, it is often overlooked. Patients with NCCP are often underdiagnosed and untreated despite their benign nature. Trigger points in the pectoral muscles can be a source of pain referred to the chest wall and may cause ipsilateral chest pain that radiates down the ulnar side of the arm. It can mimic angina pectoris.[12] Therefore, it is important to consider the diagnosis of NCCP to avoid unnecessary high-risk procedures and apply appropriate treatment.

We found that trigger point injection plus exercise was superior to exercise alone in pain reduction in both short-term and long-term follow-up. To the best of our knowledge, this study is the first randomized controlled trial to evaluate the effect of trigger point injection plus exercise versus exercise alone in the treatment of NCCP in patients presenting to the cardiology outpatient clinic.

Shin et al.[17] administered an ultrasound-guided trigger point injection into the subscapularis and pectoralis muscles in 19 postmastectomy patients who developed chest pain and achieved successful results, which were similar to our results. Several studies reported effective results with exercise, dry needling, hotpack therapy, deep friction massage, and cognitive behavioral therapy in the treatment of NCCP associated with myofascial pain.[17-19]

In a case report, Westrick et al.[20] evaluated and treated a 22-year-old male military athlete with anterior chest pain refractory to traditional physical therapy using dry needling. They reported that trigger point dry needling in suitable hands is effective in treating local chest pain. In our study, trigger point injection was also found to be effective in NCCP.

In a case series presented by Vargas-Schaffer et al.,[21] trigger point injection was applied for chest pain associated with trigger point in the serratus anterior muscle, and it was seen that all patients had experienced a significant reduction in pain. Their results were also similar to our results.

Berg et al.[18] found in a randomized controlled trial that treatment with deep friction massage with heat pack was significantly more efficient than heat pack alone to decrease musculoskeletal chest pain. Health-related quality of life scores showed no differences between groups. Similar results were observed in our study as well.

While inactivation of trigger points represents a challenge in treatment, there are various physical therapy modalities that are used to control and loosen taut bands. Common physical therapy modalities

include trigger point injection, hotpack, cold application, ultrasound, therapeutic massage, dry needling, stretch and spray technique, biofeedback using electromyography), skin conduction techniques, and transcutaneous electrical nerve stimulation.[14] Exercise is also effective in reducing pain. In a study by Navarro-Santana et al.,[22] a superior effect of TrP injection (wet needling) was suggested for decreasing pain in cervical muscle TrPs in the short term compared to dry needling. Moreover, Allam[23] concluded that the combined use of acupuncture and trigger point injection with lidocain provided promising results for pain relief in poststernotomy syndrome patients.

We found that patients who were treated with exercise together with the injection treatment on the taut band and trigger points in the pectoralis muscles showed significantly greater improvement in pain reduction compared to the group who received exercise alone ($p<0.001$). This study showed that trigger point injection is an effective, rapid, and safe treatment method in patients with NCCP secondary to MPS. Nottingham Health Profile scores increased in both groups, and there were no between-group differences at baseline or at the three-month follow-up ($p=0.522$). These results showed that exercise therapy improved quality of life as much as injection therapy.

Although exercise therapy is also an effective method, patient compliance and sustainability are low in daily practice. Combining exercise with injection therapy may increase patient compliance. Although trigger point injection has been shown to be an effective treatment method in body parts such as the neck and back in many studies, it is not preferred in the treatment of chest pain, probably due to the risk of pneumothorax.[24] No complications occurred in any of the patients in our study. This shows that trigger point injection is a safe and preferable treatment for NCCP secondary to MPS.

The limitations of this study are the small sample size and treatment of patients with trigger points and taut bands in the pectoralis muscle only.

In conclusion, this study showed that trigger point injection and exercise treatment significantly reduced chest pain compared to exercise alone. The posttreatment effect persisted for up to three months. Trigger point injection is an effective, fast, and safe treatment method in patients with MPS-associated NCCP. Although exercise therapy is also an effective method, its combination with injection therapy provides better results in patient compliance and sustainability. This study demonstrated promising results that require further research with larger sample sizes.

Acknowledgements: We would like to thank Serdar Kesikburun, MD., Evren Yaşar, Professor, MD. and Arif Kenan Tan, Professor, MD. for their supervision.

Ethics Committee Approval: The study protocol was approved by the Zekai Tahir Burak Women's Health Training and Research Hospital Clinical Research Ethics Committee (date: 21.02.2019, no: 09/2019). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Data curation, formal analysis, supervision: M.Ş.; Writing-original draft: Conceptualization, data curation, formal analysis: S.T.Ş.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

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