Research Article / Araştırma Makalesi

The Effect of One Session Osteopathic Manuel Treatment on Femoral Artery Diameter and Flow in Patients Diagnosed with Peripheral Arterial Disease

Periferik Arter Hastalığı Tanılı Hastalarda Tek Seans Osteopatik Manuel Tedavinin Femoral Arter Çapı ve Debisine Etkisi

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Abstract: The aim of this study is to investigate the effect of a single osteopathic manuel treatment (OMT) session on femoral artery diameter and flow in patients diagnosed with (Peripheral Arterial Disease) PAD. 15 patients, diagnosed with PAD, (11 male, 4 female) were included in the study. The OMT circulation model was applied to the participants for one session. Before and after the application, femoral artery diameter and flow were evaluated by radiologist. Evaluating the diameter and flow parameters according to affected extremity, it was found that femoral artery diameter and flow values showed an increase in all patients; however, the difference was not found to be statistically significant. However, comparing diameter and flow parameters in all patients showed an increase in left and right femoral artery diameter and flow. Right femoral artery diameter parameter was found to have a statistically significant difference when compared to the parameter before the application of OMT (p=0,014). While a single session of OMT did not yield statistically significant results in artery diameter and flow in affected extremities, clinically increases were detected.
Keywords: Artery Diameter, Artery Flow, Osteopathic Manuel Treatment, Peripheral Arterial Disease,

Özet: Bu çalışmanın amacı (Periferik Arter Hastalığı) PAH tanılı hastalarda tek bir osteopatik manuel tedavi (OMT) seansının femoral arter çapı ve debisi üzerine etkisini araştırmaktır. Çalışmaya PAH tanısı alan 15 hasta (11 erkek, 4 kadın) dahil edildi. Katılımcılara tek seans olarak OMT dolaşım modeli uygulandı. Uygulama öncesi ve sonrası femoral arter çapı ve debisi radyolog tarafından değerlendirildi. Etkilenen ekstremiteye göre çap ve debi parametreleri değerlendirildiğinde, tüm hastalarda femoral arter çapı ve akım değerlerinin artış gösterdiği bulundu; ancak aradaki fark istatistiksel olarak anlamlı değildi. Tüm hastalarda çap ve debi parametreleri karşılaştırıldığında sol ve sağ femoral arter çapı ve akışında artış olduğu görüldü. Sağ femoral arter çapı parametresi OMT uygulanmadan önceki parametreye göre istatistiksel olarak anlamlı farklılık gösterdi (p=0,014) Tek seans OMT ile, etkilenen ekstremitelerdeki arter çapı ve debisinde istatistiksel olarak anlamlı sonuçlar olmazken, klinik olarak artışlar sağlanmıştır.
Anahtar Kelimeler: Arter Çapı, Arter Debisi, Osteopatik Manuel Tedavi, Periferik Arter Hastalığı

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1. Introduction

Peripheral arterial disease (PAD) is a chronic atherosclerotic process which causes narrowing of peripheral arteries in lower extremities. It has a global prevalence of up to 10%, which rises to about 30% in patients over 50 (1). PAD is asymptomatic in most patients, the earliest symptom being the pain accompanying walking which is known as intermittent claudication (IC). The most frequent type of the disease is critical limb ischemia (CLI), which, if not treated urgently, may result in loss of limbs or death (2).

Pathogenesis of atherosclerosis in peripheral arterial disease consists of three factors: Biological environment, hemodynamic factors and genetic factors (3). PAD and other cardiovascular diseases share common atherosclerotic risk factors. These risk factors are age, sex, ethnicity, smoking status, diabetes, hypertension, hyperlipidemia and chronic kidney disease (4).

PAD possesses various pathological and clinical features. Pathological features are C-reactive protein (CRP), fibrinogen, hyperhomocysteinemia and lipoprotein (a), while clinical features are claudication, acute limb ischemia (ALI), tissue loss – necrosis, critical limb ischemia (CLI), interruption of regular blood flow to limbs, degradation of functional status and limb death. (5).

In order to reduce cardiovascular ischemic events and to improve functional status, patients with PAD should receive a comprehensive treatment program that includes structured exercise and lifestyle modification (5). All treatment plans should include aggressive modification of the risk factors. Treatments plans may include doing specific exercises smoking cessation, weight loss and following a specific diet. Treatments for hyperlipidemia, hypertension, diabetes and inflammation as well as homocysteine level treatment may be included in the plans as well. Antiplatelet drug treatments might also be incorporated into the treatment plan (1, 6). Furthermore, endovascular and surgical revascularization methods are used for critical limb ischemia (5).

There are some studies in the literature which examine lower limb circulation support through manual therapy (7-9). One of these manual therapy methods is osteopathic manual therapy.

Osteopathic manual therapy (OMT) was founded by A. Taylor Still in 1874. OMT has its own principles and philosophy (10). OMT has a concept of 5 models: Biomechanical model, respiratory/circulatory model, neurological model, bioenergy model and psychobehavioural model (11).

Circulatory model, developed by Kuchera (12), that aims to improve circulatory homeostasis deals with protection and improvement of extracellular space via transportation of oxygen and food and removal of metabolic waste. The clinical aim in this model is to define and remove basic tissue stresses that block the flow or circulation of body fluids (13). Therapeutic application of OMT targets somatic dysfunctions that affect respiratory mechanics, circulation and flow of body fluids (11).

Jardine et al. (7) studied the effect of OMT on superficial artery resistance in patients with knee osteoarthritis and they found a significant difference in blood flow and decrease in resistance. Thomaz et al. (9) used OMT in patients to investigate the acute response of OMT on heart rate, blood pressure and resistance in vessels. As a result, they reported that a single session of OMT does not effect blood flow in patients with cardiac failure. Lombardini et al. (8) investigated the effect of osteopathic manual therapy on ABI, quality of life and physical performance in patients with PAD, ABI, quality of life and physical performance parameters were improved. Recent studies have evaluated artery flow, resistance, quality of life and physical performance, but there is no study examining artery diameter and flow in individuals with PAD.

This study was planned on the basis that, when all physiological effects of OMT was taken into consideration, it could improve

circulation, especially peripheral limb circulation, and change artery diameter and flow.

The aim of this study is to investigate the effect of a single OMT session on femoral artery diameter and flow in patients with PAD.

2. Materials and Methods

The study was approved by Gazi University Non-Interventional Clinical Research Ethics Board. (Decision no: 24074710-11, Dated 10.04.2017). Informed consent was obtained from all participants.

2.1. Individuals

Volunteering patients aged 35-65, who had the clinical onset of peripheral vascular disease at least 3 months ago, had an Ankle - Brachial Index (ABI) value of 0,4 - 1,4, and who were classified up to Stage II B according to Fontaine Classification system were admitted to Radiology Clinic in order to have their femoral arterial diameter and flow evaluated through Colour Doppler Ultrasound. Individuals who had undergone vascular or endovascular surgeries within the last 3 months and who had histories of unstable angina, myocardial infarctions (MI), strokes, cardiac, liver or renal failures, acute infections or neoplasia were excluded from the study.

2.2. Evaluations and Interventions

Participants admitted to the radiology clinic were evaluated by the radiologist and the evaluations were recorded. Following the radiological evaluations, osteopathic manual therapy applications were administered by an osteopath who had undergone a special training for 1350 hours on the subject. After the administration of circulatory OMT model for 30 minutes, participants had another visit to the radiologist to get another Doppler Ultrasound scan, and the resulting data were recorded.

Femoral artery diameter and flow measurements were taken by the radiologist via the Logiq P5 GE (USA, GE Healtcare) device through 11L linear probe. In this proccess, artery wall contour specifications were evaluated and its diameter was measured in B-mode. Artery filling volume, patency, flow direction and potential turbulent flow were evaluated with colour Doppler. Spectral Doppler was used to measure peak systolic and end-diastolic velocity, flow pattern and current flow (14).

A protocol based on the circulatory model of Osteopathic manual therapy was applied to the participation patients. The protocol comprised occipital release, supraclavicular release, sternum mobilization, lesser omentum relaxation, liver pumping, diaphragm mobilization, grand manoeuvre as well as general osteopathic manual therapy of hips, knees and ankles. The techniques were applied for a total of 30 minutes, with each technique taking 3 minutes. For hips, knees and ankles, both extremities of the patients were treated within the allocated 3 minutes.

2.3. Statistical Analysis

SPSS® (Statistical Package for Social Sciences) version 22 was used to analyze the data obtained from the study and create tables. Kolmogorov Smirnov test was used to investigate the suitability of quantitative variables for normal distribution. Mean±standard deviation (Mean±SD) values were given as descriptive values for data that conformed to normal distribution, and median (minimum-maximum) values were given for data that did not comply with normal distribution. T Test was applied for values that met the normal distribution condition, and Wilcoxon Test was applied for values that did not meet the normal distribution condition. Statistical significance level was evaluated as $p<0.05$.

3. Results

Eleven male (73,3%) and four female (%26,7) patients with an average age of 54.86±8.89 were included in the study. 6 patients had right affected extremity, 6 patients had left affected extremity and 3 patients had bilateral affected extremity. Demographics of participants are listed in Table 1. Evaluating the diameter and flow parameters according to

affected extremity, it was found that femoral artery diameter and flow values showed an increase in all patients; however, comparing the values before and after the application, the difference was not found to be statistically significant (p>0,05) (Table 2).

However, comparing diameter and flow parameters in all patients showed an increase in left and right femoral artery diameter and flow. Right femoral artery diameter parameter was found to have a statistically significant difference when compared to the parameter before the application of OMT (p=0,014) (Table 3).

Table 1. Demographic information

	OMT (n=15) Mean±SD		
Age (year)	54,86±8,89		
Height (cm)	168,53±8,49		
Body weight (kg)	75,66±15,74		
BMI (kg/m^2)	26,49±4,51		
Affected side	Right 6	Left 6	Bilateral 3

Table 2. Comparison of artery diameter and flow values following a single session of OMT according to affected extremity

			Pre-application Mean±SD	**Post-application Mean±SD**	**Change Mean±SDv**	**t,Z**	**P**
Diameter(mm)	**Right affected (n=6)**	**Right**	7.3 ± 1.4	7.8 ± 1.4	-0.5 ± 1.3	t= 0.991	0.367
		Left	7.7 ± 1.7	7.9 ± 1.8	-0.2 ± 1.5	t= 0.356	0.736
	Left affected (n=6)	**Right**	6.1 (6.0-7.0)*	6.4 ± 1.2	-0.1 ± 0.9	t= 0.142	0.893
		Left	5.9 (5.1-8.5)*	6.6 ± 1.1	-0.5 ± 0.6	t= 1.909	0.115
	Bilateral (n=3)	**Right**	6.5 ± 1.5	7.3 ± 1.8	-1.0 (-1.0– -0,5)*	Z= 1.633	0.102
		Left	7 (7.0-8,5)*	7.3 ± 1.0	0.0 (0.0-0.5)*	Z= 1.000	0.317
Flow(ml/min)	**Right affected (n=6)**	**Right**	384.6 ± 125.2	500.0 ± 139.8	-115.4 ± 128.7	t= 2.196	0.079
		Left	460.4 ± 186.3	552.5 ± 320.7	-92.1 ± 354.3	t= 0.637	0.552
	Left affected (n=6)	**Right**	390.8 ± 181.3	297.5 (290.0-520.0)*	54.2 ± 179.8	t= 0.738	0.494
		Left	344.2 ± 154.1	406.7 ± 118.8	-62.5 ± 81.2	t= 1.885	0.118
	Bilateral (n=3)	**Right**	381,7 ± 174,7	541.7 ± 298.3	-160.0 ± 127.7	t= 2.171	0.162
		Left	403,3 ± 106,8	406.7 ± 202.5	-3.3 ± 97.8	t= 0.059	0.958

**: Median(min-max), t: parametric statistical test, Z: non-parametric statistical test*

Table 3. Comparison of artery diameter and flow values following a single session of OMT in all patients

		Pre-application Mean±SD	Post-application Mean±SD	Change Mean±SDv	t,Z	P
Diameter (mm) (n=15)	**Right**	6,75±1,15	7,16±1,34	-0,41±0,56	t=2,824	**0,014**
	Left	7,03±1,49	7,32±1,56	-0,29±0,65	t=1,737	0,104
Flow (ml/min) (n=15)	**Right**	386,50±147,33	446,66±138,61	-60,16±128,44	t=1,814	0,091
	Left	402,50±159,37	467±194,84	-64,50±160,46	t=1,557	0,142

t: parametric statistical test, Z: non-parametric statistical test

4. Discussion

In our study examining the effect of a single OMT session on femoral artery diameter and flow in PAD patients, the results showed that OMT application increases right artery diameter and there is no difference in flow.

The objective in treating patients with PAD is to improve quality of live by relieving symptoms and to reduce vascular morbidity and mortality (6). There are studies in literature reporting positive effects of manual therapy applications on systemic circulation (7, 8, 15-21). Being one such application, OMT targets somatic dysfunctions that affect mechanics of respiration, circulation and flow of body fluids. Many of the techniques used in OMT are designed to improve homeostatic mechanisms related to the circulatory system. Lympathic treatments aim to increase the functional capacity of arterial, venous and lympatic system and to improve fluid balance and immune response of the body. As lympathic system has a role in tissue nutrition and absorbtion of macronutrients from gastrointestinal system and interstitial fluids, it can be indicated that treatments which improve lympathic function has a curative effect in many circulatory pathologies (11).

Hodge et al. (19), in their study that investigated whether abdominal lympathic pumping technique increased leukocytes in both thoracic and mesenteric duct lymphs and whether mesenteric lymph nodes were the source of these leukocytes, used abdominal lympathic pumping technique on dogs and subsequently took thoracic and mesenteric lymph measurements. Their results indicate that lympathic pumping technique could initiate immune responses that could accelerate the clear-up of infections. Furthermore, the study indicated that lympatic pumping technique mobilized leukocytes into lympathic circulation. In the light of the data acquired in this study, they indicate that abdominal lympathic pumping could be seen as a treatment option in improving immune response.

Huff et al. (22), aimed to create a rat model to determine whether they could see lymph flow and leukocyte concentration improvements through lympathic pumping similar to those observed in the dog model. They applied abdominal lympathic pumping techniques on 10 rats in the study, and then checked the leukocyte count in central circulation. Lympathic pumping treatment was found to increase leukocyte count in central circulation and was shown to mobilize gut-associated leukocytes into central circulation.

In another compilation, Hodge (23), interpreted clinical and basic scientific studies that support using lympathic pumping technique in order to improve lympathic and immune system. Discussing potential mechanisms that could help the patients, the studies included in the compilation were found to indicate that lympathic pumping could contribute to immune system treatments and treatment of pneumonia. Following the results of her compilation, Hodge asserted that clinical studies in question indicated the fact that lympathic pumping was related to increased blood leukocyte count, antibody response against bacterial antigens, immunization, intravenous antibiotic

treatment and shortening of hospital stays. She also asserted her support in the hypothesis that lympathic pumping strengthened lympathic and immune system and protected against pneumonia as evidenced in recent animal studies. Stating that the role lympathic pumping technique plays in increasing the ability of immune system to destroy bacteria is not quantitatively defined, Hodge expressed the need for further clinical studies using animal models in order to determine the efficiency of protection mechanisms resulting from lympathic pumping technique.

As is known, mature lymphocytes that carry antigen-specific receptors are located along periperhal or secondary lymphoid organs in the lympathic system. These mature lymphocytes are known to enter back into blood citculation via lympathic vessels. Most adaptive immune responses support the idea that lymphocytes in circulation are triggered once they recognize the specific antigens on the surface of cells that present these antigens (13). It can be said that manual therapy applications that regulate periperhal circulation boost the immune system through both improving blood and lymph circulation and increasing lymphocyte count in circulation. This study also proves that manual therapy increases circulation as evidenced by the increase in artery diameter and flow.

Jardine et al. (7) studied the effect of osteopathic manual therapy on superficial artery resistance in patients with knee osteoarthritis. The treatment, which focused on balancing fascial restrictions and diaphragm tensions, was found to decrease resistance in superficial femoral artery. This finding indicates the direct and immediate effect of osteopathic manual treatment methods on blood flow dynamics in lower extremities. Manual therapy procedures in this study involved both evaluating fascial tissues and releasing fascial restrictions, therefore, a significant difference in blood flow in relation to the decrease in resistance was acquired.

Studying the effects of OMT on hypertension with a view to preventing long term cardiovascular conditions, Cerritelli et al. (24) indicated that, when the OMT group was compared to the control group through observing routinely used clinical parameters, it was found that OMT was instrumental in decreasing the formation of inflammatory effects and improving intima-media thickness and blood pressure values. They also stated that OMT, by restructiring the physiological function of spinal cord, could improve the functionality of the sympatethic nervous system affected by the cardiovascular system.

Thomaz et al. (9) used cranial, myofascial and visceral osteopathy technigues on patients in their study with the purpose of evaluating the acute response of OMT on heart rate, blood pressure and resistance in vessels. Comparing the OMT gorup with the control group, they indicated that there were no significant differences in the parameters taken immediately after a single OMT session. As a result, they reported that a single session of OMT does not effect blood flow in patients with cardiac failure. Similarly, in our study, there was no effect with a single session of treatment. These findings were explained through patient population, changes in autonomous nervous system, vascular regulation in patients with cardiac failure, medication used by patients and blood flow that is not sensitive to vessel resistence after only a single session of OMT.

Lombardini et al. (8) investigated the effect of osteopathic manual therapy on ABI, quality of life and physical performance in patients with PAD and indicated that ABI, quality of life and physical performance parameters improved. They reported that, along with other manual therapies, OMT was instrumental in helping circulation and increasing blood flow in periperhal vascular tissue. These positive findings were despite the fact that a more generalized application of OMT was used in the study. In our study, the difference in arterial diameter was detected only on the right side. Although there was a difference in artery flow, it was not statistically significant. We think that this situation is related to the low number of our patients. We believe that if the study had been conducted with a high number of patients, it would have been reflected in the statistics. Backer et al. (25) indicated that this effect could, in part, be modulated by nitric oxide

(NO); Salamon et al. (26) presented their findings supporting that physical manipulation accelerated release of endothelial NO synthase.

Walkowski et al. (15) used a 7-minute treatment consisting of lympathic, splenic and hepatic pumping techniques in their study aiming to investigate the possibility of OMT making an immediate change in cytokine and leukocyte levels in circulation. Bloodletting process was conducted three times, an hour before the application as well as 5 and 30 minutes after it. The blood analysis indicated that, when compared to the levels taken before OMT, there was a small but meaningful decrease in NO levels only in the OMT group an hour after the treatment; yet, there were no observable difference in CRP levels between OMT and control groups. However, in the same study, it was stated that OMT could be used as an immune system supporting treatment option with responses evident in different immune-modulating mediators.

Nitric oxide is not only an immune, vascular and neural signal molecule, but it also boasts antibacterial and antiviral effects (27-29). Looking at the vascular effects of NO, it can be seen that it regulates endothelium regulation and has a vasodilating effect with increased release. This NO-induced vasodilation has the potential to protect a tissue from both microorganisms and physiological dysfunctions such as hypertension (26).

Patients receiving OMT report a feeling of wellness as a result of outcomes of physiological manipulation of muscle structure such as peripheral vasodilation, heating of skin and lowered heart rate. This process is called relaxation response. It has been stated that OMT improves inner balance by removing restrictions on blood and lymph flow, optimizing respiratory mechanics and recreating balance between sympathetic and parasympathetic nervous systems (11). Looking at the potential mechanism for osteopathic manipulation, it can be seen that periphreal neurovascular processes are just as significant as the relaxation of complex central nervous system through autonomous nervous system. NO is considered to play a highly significant role in all these mechanisms due to its role in the increase of vasodilation (30-32).

Limitations

The number of patients participating in our study is small. There is a need for further studies in which parameters such as NO are also evaluated along with radiological evaluations and in which a broader participation, and a longer duration of OMT application are available to look into similar effects found in our study. These elements constitute the limitations of our study.

5. Conclusion

In our study, peripheral vasodilation effects stemming from the possibility that OMT induces NO synthesis led to increase in artery diameter and flow increases in patients and had an effent on clinical functions of participants. Literature clearly suggests that, both in animal and human studies, manual therapy contributes to systemic circulation. In our study, a single session of OMT increases the right artery diameter statistically significant. Although there is no statistical diffencence in flow, clinically increases were detected. Considering that the diameter on the right side increases statistically significant even with a single session, we believe that if the study was conducted with more sessions rather than a single session, this change in blood flow and diameter would be reflected in the statistics. Further research is needed on this subject.

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Ethics

Ethics Committee Approval: The study was approved by Gazi University Non-interventional Clinical Research Ethical Committee (Decision no:138, Date: 10.04.2017).
Informed Consent: The authors declared they get consent from the patients
Authorship Contributions: MAO conceived the idea for the study. MAO,NAG, İK and DE contributed to the design and planning of the research. DE directed the individuals to study. MKA made the radiological evaluation. MAO made the interventions. All authors were involved in data collection. MAO, NAG and İK analyzed the data. MAO and NAG wrote the first draft of the manuscript. All authors edited and approved the final version of the manuscript.
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