ISSN: 2618 – 5911
Turkish Journal of Sports Science
2025; 9(1);1-9
DOI: 10.32706/tusbid.1693061

Research Article

Comparison of Acute Effects of Classical Massage and Connective Tissue Massage on Lower Extremity Blood Flow Changes[1]

İsmail PALALI[2]　　Özlem ALTINDAĞ[3]

Abstract

This study aimed to compare the immediate effects of connective tissue massage and classical massage on lower extremity blood circulation in healthy adults, and to better understand the mechanism of connective tissue massage. Twenty healthy participants underwent a 40-minute classical massage on the left lower limb. One week later, the same individuals received a connective tissue massage. Using color Doppler ultrasound, the diameter, flow velocity, and blood volume of the popliteal and posterior tibial arteries were measured before and after each session. Both massage methods led to significant increases in blood flow velocity, vessel diameter, and blood volume ($p<0.05$). However, connective tissue massage was more effective than classical massage in increasing the flow velocity and volume in the popliteal artery, as well as the diameter and volume in the posterior tibial artery ($p<0.05$). There was no significant difference between the two techniques regarding the diameter of the popliteal artery and the flow velocity of the posterior tibial artery ($p>0.05$). Overall, while both methods improved circulation, connective tissue massage produced greater improvements in peripheral blood volume, suggesting it may be more beneficial when enhanced vascular response is desired.

Keywords: Blood Circulation, Connective Tissue, Doppler Color Ultrasonography, Lower Extremity Massage.

Klasik Masaj ve Konnektif Doku Masajı Uygulamalarının Alt Ekstremite Kan Akış Değişiklikleri Üzerine Olan Akut Etkilerinin Karşılaştırılması

Öz

Bu çalışma, sağlıklı yetişkinlerde konnektif doku masajı ile klasik masajın alt ekstremite kan dolaşımı üzerindeki anlık etkilerini karşılaştırmayı ve konnektif doku masajının etki mekanizmasını daha iyi anlamayı amaçlamıştır. Yirmi sağlıklı katılımcıya sol alt ekstremiteye 40 dakikalık klasik masaj uygulanmıştır. Bir hafta sonra aynı bireylere konnektif doku masajı yapılmıştır. Popliteal ve posterior tibial arterlerin çapı, kan akış hızı ve kan hacmi her uygulamadan önce ve sonra olmak üzere renkli Doppler ultrason ile ölçülmüştür. Her iki masaj yöntemi de kan akış hızı, damar çapı ve kan hacminde anlamlı artış sağlamıştır ($p<0,05$). Ancak, konnektif doku masajı popliteal arterdeki akış hızı ve hacim ile posterior tibial arterdeki çap ve hacmi klasik masaja göre daha fazla artırmıştır ($p<0,05$). Popliteal arter çapı ile posterior tibial arter akış hızı açısından iki yöntem arasında anlamlı bir fark bulunmamıştır ($p>0,05$). Genel olarak her iki masaj yöntemi de dolaşımı artırsa da, konnektif doku masajı periferik kan hacmini artırmada daha etkilidir. Bu bulgular, terapötik hedeflere göre uygun masaj tekniğinin seçilmesinde klinisyenlere yol gösterebilir.

Anahtar Kelimeler: Kan Dolaşımı, Konnektif Doku, Doppler Renkli Ultrasonografi, Alt Ekstremite Masajı

[1] This article is based on a Master's thesis
[2] Corresponding Author: Harran University, Faculty of Health Sciences, Şanlıurfa-Türkiye. ismail.palali01@gmail.com
[3] Gaziantep University, Medical Faculty, Gaziantep-Türkiye. ozaltindag@yahoo.com

Citation/Atıf:Palalı, İ.,Altındağ, Ö.(2025). Comparison of Acute Effects of Classical Massage and Connective Tissue Massage on Lower Extremity Blood Flow Change. *Turkish Journal of Sports Science,* 9(1):1-9. DOI:10.32706/tusbid.1693061

Received:06.05.2025
Accepted: 18.06.2025

INTRODUCTION

Manual therapy, which includes a wide variety of techniques such as soft tissue mobilizations, massage, myofascial release, joint mobilizations or manipulations, and nerve mobilizations, is defined as a touch-based conservative treatment approach used to assess and treat various symptoms and conditions (Clar et al., 2014; Roura et al., 2021). Among these techniques, massage is an ancient practice that has been utilized for thousands of years for health and wellness purposes (Rodrigues et al., 2020). Many massage techniques used in clinical settings are advantageous due to their affordability, accessibility, and safety (Er & Yüksel, 2023).

Massage therapy has the potential to enhance local and peripheral blood flow and volume, deliver oxygenated blood to muscles, and promote muscle relaxation (Portillo-Soto et al., 2014; Supa'at et al., 2013 ; Walaszek, 2015;). Although it has been reported that massage can increase blood volume and improve circulation, findings in the literature are inconsistent (Portillo-Soto et al., 2014; Roura et al., 2021; Supa'at et al., 2013; Goats, 1994; Shoemaker et al., 1997). Some studies have even shown that massage does not produce significant changes in blood flow (Shoemaker et al., 1997; Hinds et al., 2004; Tiidus & Shoemaker, 1995).

Classical massage (CM), also known as Swedish massage, is widely applied in clinical settings and primarily targets dermal, subcutaneous, and muscular tissues. This technique can cause vasodilation through blood vessel expansion. Connective tissue massage (CTM), on the other hand, is a reflex therapy technique aimed at balancing sympathetic and parasympathetic components of the autonomic nervous system by stimulating autonomic nerve pathways through connective tissue manipulation (Akbaş et al., 2019; Holey & Dixon, 2014; Yuan et al., 2015). CTM differs from CM in both its physiological effects and application technique. Evidence is growing for its influence on autonomic function (Holey et al., 2011; Toprak Celenay et al., 2023). Although not fully conclusive, studies on CTM's physiological impact suggest it modulates autonomic nervous activity, particularly in cardiovascular parameters such as blood pressure and flow (Bartsch et al., 2021; Holey & Dixon, 2014; Holey & Dixon, 2018).

Because of their effects on circulation, both massages are widely used in clinical practice for therapeutic purposes. However, it is not known which form is more effective on blood flow. The aim of this study is to investigate the acute effects of two different manipulative methods, CTM and CM, on hemodynamic changes in the lower extremities in healthy individuals and to compare the two techniques in terms of superiority.

METHOD

Participants

According to the power analysis based on patient and healthy control group data in a previous study (Taşpınar, 2010) in which the effectiveness of Matrix Rhythm Therapy in increasing peripheral blood circulation compared to Classical Massage was evaluated, α error 0.05, β error 0.15 (power: 0.85), the required minimum sample size was calculated as 20 for each group.

Twenty healthy volunteers, 8 female and 12 male, aged between 19 and 37 who signed the Informed Consent Form in Istanbul Erenköy Physical Therapy and Rehabilitation Hospital between November 2017 and December 2018 were enrolled in this study. Approval for the study was obtained from the Erenköy Mental Health and Neurology Training and Research Hospital Clinical Research Ethics Committee (number, 27; date, 06.11.2017).

Individuals who had a history of allergies, neurological or orthopedic disease, smokers, active athletes, those who were receiving medical treatment (eg vasodilator drugs), having regular massage interventions, individuals who had a circulation problem, and those who had a musculoskeletal injury at least one month before the study were excluded from the study. Changes in the popliteal artery and posterior tibial artery's diameter, blood flow velocity, and amount of blood volume were measured with a linear probe using a color doppler ultrasound device (MedisonSonoAce X8) before and after the intervention in all individuals who participated in the study. All measurements were performed by a radiologist blinded to massage treatments. Flow rate measurements were evaluated at room temperature (22°C) and at 30-60°C doppler angle (Figure 1). Popliteal artery evaluation was made from the popliteal fossa between the medial and lateral heads of gastrocnemius muscles. Posterior tibial artery evaluation was performed on the ankle behind the medial malleol. The Doppler insonation angle was kept between 30-60 degrees during the velocity measurements (Hwang, 2017).

Figure 1. Measurements with color Doppler ultrasonography.

Measurements of the popliteal artery and posterior tibial artery were included in the evaluations, and the diameters were measured from the anterior-posterior cross-section. Maximum systolic volume was measured in order to assess the blood volume and the amount of blood volume was calculated and recorded by taking into account the mean value of three measurements in order to prevent measurement error.

The participants were asked to rest in the bed for 15 minutes before the massage intervention and measurements.

Intervention

All patients who were included in the study were given CM therapy, their measurements were repeated after the therapy, and then one week later they were given CTM therapy and re-evaluated.

Before CM intervention, patients were first laid on their back and a pillow was placed under the extremity on which massage was to be performed. CM was applied on the quadriceps, biceps femoris, tensor fascia latae, semimembranosus, semitendinosus, tibialis anterior, peroneus brevis and longus, gastrocnemius, the soleus muscles, and the adductor muscles of the thigh. Typical CM techniques were used during the intervention, such as stroking with the palms (effleurage), friction with the palms, kneading (petrissage), percussion (tapotement) and vibration (Kassolik et al., 2013). Stroking was applied as 50-60 times and kneading 30 times per minute. Kneading was applied with circular movements with fingertips. During the massage, hand-skin contact was not interrupted. Applied in accordance with body contours with palms and fingers. The intervention was continued for 40 minutes.

CTM intervention was applied firstly on the primary region, i.e. the sacral region, and then continued to the quadriceps, biceps femoris, tensor fascia latae, semimembranosus, semitendinosus, tibialis anterior, peroneus brevis and longus, gastrocnemius, the soleus muscles, and the adductor muscles of the thigh. The intervention commenced with a series of short strokes over the sacrum, lumbar spine and posterolateral pelvis, which were developed into longer paravertebral and subcostal strokes. It was then completed by applying strokes to the front of the thigh, the back of the thigh, and the knee and calf, respectively. During the intervention, traction was created between the middle fingers of both hands and the cutaneous tissues (Yüksel et al., 2013). The intervention was conducted with long and short pulling strokes for 40 minutes. CM and CTM interventions were performed by the same physiotherapist who has 8 years of experience in massage.

Data Analysis

The data obtained in the study was analyzed using the SPSS 20.0 package software. Descriptive data were presented with minimum-maximum and mean ± standard deviation values. Data was not normally distributed and therefore, nonparametric statistical methods were selected. The Wilcoxon Signed Rank Test was used in order to determine the effectiveness of the methods employed in the study. The Mann Whitney U Test was used in order to analyze the differences between the measured values before and after the interventions. The significance level was set as $p<0.05$ for all analyzes

RESULTS

20 healthy volunteers, eight females (40%) and 12 (60%) males, were included in the study. The age, height, body weight and body mass index findings of the participants were presented in (Table 1).

Comparison of the sonographic measurements of Group 1 (CTM) and Group 2 (CM) before the therapy revealed that there was no significant difference between the groups in terms of blood vessel diameter (D), amount of blood volume (BV) and mean blood flow velocity (MBFV) ($p>0.05$) (Table 2).

Table 1. Demographic Characteristics of the Participants.

Variables	n	Minimum	Maximum	Mean
Age (year)	20	19	37	23.75 ± 2.12
Height (cm)	20	157	190	167.77 ± 7.4
Body weight (kg)	20	54	90	62.5 ± 3.53
BMI (kg/m2)	20	19.91	26.02	23.68 ± 0.92

BMI: Body Mass Index.

According to the comparison of sonographic values obtained from the popliteal artery and posterior tibial artery before and after CM, blood vessel diameter, blood volume velocity and amount of blood volume exhibited an increase that was statistically significant ($p<0.05$) (Table 2). According to the comparison of sonographic values obtained from the popliteal artery and posterior tibial artery before and after CTM, blood vessel diameter, blood flow velocity and amount of blood volume exhibited an increase that was statistically significant ($p<0.05$) (Table 2).

Table 2. Comparison of Sonographic Values Before and After Massage Interventions (N=20).

Classical Massage Intervention (n=20)		Before Mean±SD	After Mean±SD	*p*
Popliteal artery	Diameter of vessel (mm)	4.7±0.39	5.1±0.44	< 0.001*
	Velocity blood mean (cm/sec)	52.3±11.1	56.7±10.2	0.005*
	Blood volume (ml/min)	998±202	1134±297	0.003*
Posterior tibial artery	Diameter of vessel (mm)	3.91±0.51	4.1±0.47	0.003*
	Velocity blood mean (cm/sec)	40.33±9.76	44.21±8.43	0.004*
	Blood volume (ml/min)	744±152	820±197	0.002*
Connective Tissue Massage Intervention (n=20)		**Before Mean±SD**	**After Mean±SD**	***p***
Popliteal artery	Diameter of vessel (mm)	4.88±0.29	5.3±0.39	< 0.001*
	Velocity blood mean (cm/sec)	53.6±10.66	62.7±15.6	< 0.001*
	Blood volume (ml/min)	1040±232.2	1302±331.3	< 0.001*
Posterior tibial artery	Diameter of vessel (mm)	3.7±0,44	4±0.74	< 0.001*
	Velocity blood mean (cm/sec)	43.66±7.88	51.7±9.77	< 0.001*
	Blood volume (ml/min)	501.1±145	643.3±332	< 0.001*

SD: Standard Deviation. *: Statistically Significant Difference ($p < 0.05$)

It was found that the intervention of the CTM method resulted in a higher increase in the amount of blood volume per minute through the popliteal artery and posterior tibial artery in comparison to the CM method ($p<0.05$) (Table 3).

It was observed that the increase in the diameter of the cross-sectional area of the popliteal artery was higher after CTM intervention compared to CM. However, this increase was not statistically significant ($p>0.05$). The increase in the diameter of the posterior tibial artery was also higher in the CTM group, and this increase was statistically significant ($p<0.05$) (Table 3).

The increase in blood flow velocity through the popliteal artery was higher after CTM intervention compared to CM and the difference was statistically significant ($p<0.05$). Comparing the differences in blood flow velocity through the posterior tibial artery, the CTM group exhibited a higher increase, but it was not statistically significant ($p>0.05$) (Table 3).

Table 3. Comparison of Change Values of Hemodynamic Parameters Before and After Intervention

Vessels	Parameters	CTM (n=20) Difference (Δ)±SD	CM (n=20) Difference(Δ)±SD	*p*
Popliteal artery	Diameter of vessel (mm)	0.42±0.17	0.38±0.14	0.282
	Velocity blood mean (cm/sec)	9.1±2.4	4.4±1.3	0.009*
	Blood volume (ml/min)	262.4±103.8	136±63.8	0.014*
Posterior tibial artery	Diameter of vessel (mm)	0.3±0.12	0.19±0.1	0.03*
	Velocity blood mean (cm/sec)	8.04±2.2	3.92±1	0.22
	Blood volume (ml/min)	142±80.7	76±40.3	0.017*

SD: Standard Deviation, CTM: Connective Tissue Massage, CM: Classical Massage. *: Statistically Significant Difference ($p < 0.05$)

DISCUSSION and CONCLUSION

There is increasing interest in the use of manipulative soft tissue techniques and in studies investigating the comparative effectiveness of treatment methods applied for similar purposes but involving different mechanisms of action. In the present study, the acute changes in lower extremity blood flow following the application of connective tissue massage (CTM) and classical massage (CM) were evaluated. As anticipated, both massage techniques resulted in increased blood flow to the lower limbs. Among the two, CTM was found to be superior to CM in enhancing blood volume in the lower extremities, increasing the diameter of the posterior tibial artery, and improving blood flow in the popliteal artery.

Previous studies have widely reported that superficial blood vessels dilate and blood flow velocity increases after massage therapy (Goats, 1994; Portillo-Soto et al., 2014; Supa'at et al., 2013; Walaszek, 2015). Indicators such as localized skin redness or, more objectively, elevated blood flow measured via Doppler ultrasonography, reinforce this assertion. Taspinar et al. (2013) investigated the effects of matrix rhythm therapy and CM on blood flow in 15 healthy participants using color Doppler ultrasound. According to measurements taken from the posterior tibial and popliteal arteries, both treatments enhanced blood volume, vessel diameter, and flow velocity; however, matrix rhythm therapy yielded a greater increase compared to CM. The literature generally supports the notion that massage improves circulation, a view further validated by our current findings, which showed CTM to be more effective than CM.

Conversely, several studies have reported that massage may not significantly influence blood flow (Hinds et al., 2004; Shoemaker et al., 1997; Tiidus & Shoemaker, 1995). Shoemaker et al. (1997), using Doppler ultrasound, observed that blood flow remained unaffected regardless of massage dosage or intensity. Similarly, Hinds et al. (2004) found no significant difference in hemodynamic parameters between the CM and control groups after exercise. Our study discusses these contradictory findings in light of our own data regarding the circulatory effects of massage therapy.

Massage-induced vasodilation may be mediated by several physiological mechanisms. The literature highlights the roles of somatosensory stimulation, mechanical pressure, nitric oxide (an endothelium-derived relaxing factor), prostacyclin, various local metabolic substances, and altered blood gas concentrations (decreased O_2 or increased CO_2) in promoting vascular smooth muscle relaxation (Baratchi et al., 2017; Espí-López et al., 2020; Franklin et al., 2014; Karemaker, 2017; Korthuis, 2011; Nelson, 2015; Sato-Suzuki et al., 2019; Toprak Celenay et al., 2023; Yamamoto et al., 2018;). Somatosensory input combined with improved muscle compliance and the mechanical compression generated during massage pulses contribute to increased blood flow (Espí-López et al., 2020; Nelson, 2015). The best-established mechanism of massage therapy involves mechanical pressure-induced vasodilation leading to enhanced local perfusion (Franklin et al., 2014; Goats, 1994; Supa'at et al., 2013;). Franklin et al. (2014) also demonstrated that a single 30-minute massage improved brachial artery endothelial function for up to 48 hours, a phenomenon known as "conducted vasodilation," wherein vasodilation in distal vascular regions rapidly spreads throughout the vascular network (Franklin et al., 2014; Nelson, 2015). Similar mechanisms may have contributed to the blood flow improvements observed in our study. These explanatory models are more frequently cited in the context of CM, although our results suggest that CTM may engage similar or additional mechanisms.

To our knowledge, no prior study has directly compared the effects of CM and CTM on blood volume. Nevertheless, a study by Bakar et al. (2014) partially supports our findings. They examined pressure pain threshold and muscle relaxation using electroneuromyography in 45 women with chronic neck pain following one session of CM and CTM. CM was effective in reducing pain, while CTM showed greater effects on muscle relaxation, which the authors attributed to enhanced peripheral circulation and increased blood volume. CTM is considered a manipulative reflex therapy that stimulates distal autonomic nerve endings via mechanical traction on connective tissue.

Although its mechanism of action is not fully elucidated, CTM is thought to influence the balance between the sympathetic and parasympathetic branches of the autonomic nervous system (Holey & Dixon, 2014).

Blood vessels, except for a few specialized types, are densely innervated by the sympathetic nervous system (Karemaker, 2017). Elevated blood flow velocity due to increased sympathetic tone has been linked to vascular remodeling (Kontos et al., 2017). Previous research has demonstrated that massage therapy can affect autonomic function, often enhancing parasympathetic activity (Akbaş et al., 2019; Holey & Dixon, 2014 Roura et al., 2021). CTM in particular is known to reduce sympathetic activity and activate vasodilator reflexes by mechanically stimulating connective tissue and associated cell populations (Akbaş et al. 2019; Toprak Celenay et al., 2023) reported that CTM significantly reduced blood pressure in healthy young women, suggesting diminished sympathetic output. These findings align with our current results, where CTM was more effective than CM in enhancing lower extremity blood volume. This effect may be attributed to the reflex pathways activated by CTM rather than direct physiological mechanisms. Additionally, the sequence in which the massages were applied—CM preceding CTM—may have created a synergistic advantage for CTM. However, autonomic effects induced by manual therapy vary depending on treatment site, applied technique, and the selected measurement approach. Currently, there is no definitive evidence clarifying the specificity of autonomic outcomes based on body region or technique (Roura et al., 2021).

This study has several limitations. The relatively small sample size and the absence of long-term follow-up reduce the generalizability of the findings. The lack of a control group is another limiting factor. Additionally, the one-week interval between the two massage sessions might have allowed the effects of CM to influence the response to CTM. Future studies should incorporate a longer washout period, include a control group, and use a larger sample to validate these findings and explore long-term effects.

In conclusion, this study demonstrated that both classical massage and connective tissue massage significantly increased lower extremity blood flow, as measured by color Doppler ultrasound. CTM was more effective than CM in enhancing blood volume, vessel diameter, and blood flow velocity. Given that improving circulation is a key objective in musculoskeletal rehabilitation, both massage modalities can be incorporated into treatment programs. The results also provide guidance for clinicians when selecting soft tissue techniques based on therapeutic goals.

Author's Statement of Contribution to the Article

Idea/Concept: İsmail Palalı, Özlem Altındağ; Article design: İsmail Palalı, Özlem Altındağ; Consulting: Özlem Altındağ; Data Collection and Processing: İsmail Palalı; Analysis/Comment: İsmail Palalı, Özlem Altındağ; Literature review: İsmail Palalı; Article writing: İsmail Palalı; Critical Analysis: Özlem Altındağ; Source/Material: İsmail Palalı, Özlem Altındağ; Article Submission Corresponding Author: İsmail Palalı

Conflict of Interest

The authors have no conflict of interest to declare.

Financial support

No financial support was received for the completion of this study.

Ethics Committee Approval

This study is in line with the Declaration of Helsinki. Approval for the study was obtained from the Erenköy Mental Health and Neurology Training and Research Hospital Clinical Research Ethics Committee (number, 27; date, 06.11.2017).

Peer Review

After the blind review process, it was found suitable for publication and accepted.

REFERENCES

Akbaş, E., Ünver, B., & Erdem, E. U. (2019). Acute effects of connective tissue manipulation on autonomic function in healthy young women. *Complementary Medicine Research*, *26*(4), 250–257.

Bakar, Y., Sertel, M., Oztürk, A., Yümin, E. T., Tatarli, N., & Ankarali, H. (2014). Short-term effects of classic massage compared to connective tissue massage on pressure pain threshold and muscle relaxation response in women with chronic neck pain: A preliminary study. *Journal of Manipulative and Physiological Therapeutics*, *37*(6), 415–421.

Baratchi, S., Khoshmanesh, K., Woodman, O. L., Potocnik, S., Peter, K., & McIntyre, P. (2017). Molecular sensors of blood flow in endothelial cells. *Trends in Molecular Medicine*, *23*(9), 850–868.

Bartsch, K., & Schleip, R. J. (2021). Connective tissue manipulation. In *Fascia: The Tensional Network of the Human Body* (pp. 454–461).

Clar, C., Tsertsvadze, A., Court, R., Hundt, G. L., Clarke, A., & Sutcliffe, P. (2014). Clinical effectiveness of manual therapy for the management of musculoskeletal and non-musculoskeletal conditions: Systematic review and update of UK evidence report. *Chiropractic & Manual Therapies*, *22*(1), 12.

Er, G., & Yüksel, İ. (2023). A comparison of the effects of connective tissue massage and classical massage on chronic mechanical low back pain. *Medicine*, *102*(15), e33516.

Espí-López, G. V., Serra-Añó, P., Cuenca-Martínez, F., Suso-Martí, L., & Inglés, M. (2020). Comparison between classic and light touch massage on psychological and physical functional variables in athletes: A randomized pilot trial. *International Journal of Therapeutic Massage & Bodywork*, *13*(3), 30–37.

Franklin, N. C., Ali, M. M., Robinson, A. T., Norkeviciute, E., & Phillips, S. A. (2014). Massage therapy restores peripheral vascular function after exertion. *Archives of Physical Medicine and Rehabilitation*, *95*(6), 1127–1134.

Goats, G. C. (1994). Massage—the scientific basis of an ancient art: Part 2. Physiological and therapeutic effects. *British Journal of Sports Medicine*, *28*(3), 153–156.

Hinds, T., McEwan, I., Perkes, J., Dawson, E., Ball, D., & George, K. (2004). Effects of massage on limb and skin blood flow after quadriceps exercise. *Medicine & Science in Sports & Exercise*, *36*(8), 1308–1313.

Holey, E., & Dixon, J. (2018). Connective tissue manipulation and skin rolling. In Chaitow, L. (Ed.), *Fascial Dysfunction: Manual Therapy Approaches* (2nd ed.). Edinburgh: Handspring Publishing.

Holey, L. A., & Dixon, J. (2014). Connective tissue manipulation: A review of theory and clinical evidence. *Journal of Bodywork and Movement Therapies*, *18*(1), 112–118.

Holey, L. A., Dixon, J., & Selfe, J. (2011). An exploratory thermographic investigation of the effects of connective tissue massage on autonomic function. *Journal of Manipulative and Physiological Therapeutics*, *34*(7), 457–462.

Hwang, J. Y. (2017). Doppler ultrasonography of the lower extremity arteries: Anatomy and scanning guidelines. *Ultrasonography*, *36*(2), 111–119.

Ichimura, M., Sasaki, S., Mori, M., & Ogino, T. (2015). Tapping but not massage enhances vasodilation and improves venous palpation of cutaneous veins. *Acta Medica Okayama*, *69*(2), 79–85.

Karemaker, J. M. (2017). An introduction into autonomic nervous function. *Physiological Measurement*, *38*(5), R89–R118.

Kontos, A., Lushington, K., Martin, J., Schwarz, Q., Green, R., Wabnitz, D., et al. (2017). Relationship between vascular resistance and sympathetic nerve fiber density in arterial vessels in children with sleep disordered breathing. *Physiological Reports*, *6*(7), e006137.

Korthuis, R. J. (2011). *Skeletal Muscle Circulation*. Morgan & Claypool Life Sciences.

Nelson, N. L. (2015). Massage therapy: Understanding the mechanisms of action on blood pressure. A scoping review. *Journal of the American Society of Hypertension*, *9*(10), 785–793.

Portillo-Soto, A., Eberman, L. E., Demchak, T. J., & Peebles, C. (2014). Comparison of blood flow changes with soft tissue mobilization and massage therapy. *Journal of Alternative and*

Complementary Medicine, *20*(12), 932–936.

Rodrigues, L. M., Rocha, C., Ferreira, H. T., & Silva, H. N. (2020). Lower limb massage in humans increases local perfusion and impacts systemic hemodynamics. *Clinical Hemorheology and Microcirculation*, *128*(5), 1217–1226.

Roura, S., Álvarez, G., Solà, I., & Cerritelli, F. (2021). Do manual therapies have a specific autonomic effect? An overview of systematic reviews. *PLoS One*, *16*(12), e0260642.

Sato-Suzuki, I., Kagitani, F., & Uchida, S. (2019). Somatosensory regulation of resting muscle blood flow and physical therapy. Autonomic neuroscience : Basic & Clinical, 220, 102557.

Shoemaker, J. K., Tiidus, P. M., & Mader, R. (1997). Failure of manual massage to alter limb blood flow: Measured by Doppler ultrasound. *Medicine & Science in Sports & Exercise*, *29*(5), 610–614.

Supa'at, I., Zakaria, Z., Maskon, O., Aminuddin, A., & Nordin, N. A. (2013). Effects of Swedish massage therapy on blood pressure, heart rate, and inflammatory markers in hypertensive women. *Evidence-Based Complementary and Alternative Medicine*, 2013, 171852.

Taspinar, F., Aslan, U. B., Sabir, N., & Cavlak, U. (2013). Implementation of matrix rhythm therapy and conventional massage in young females and comparison of their acute effects on circulation. *Journal of Alternative and Complementary Medicine*, *19*(10), 826–832.

Tiidus, P. M., & Shoemaker, J. K. (1995). Effleurage massage, muscle blood flow and long-term post-exercise strength recovery. *International Journal of Sports Medicine*, *16*(7), 478–483.

Toprak Celenay, Ş., Coban, O., Mete, O., & Karahan, N. (2023). An investigation of the effects of connective tissue massage in women with migraine: A controlled clinical trial. *Journal of Bodywork and Movement Therapies*, *33*, 112–119.

Walaszek, R. (2015). Impact of classic massage on blood pressure in patients with clinically diagnosed hypertension. *Journal of Traditional Chinese Medicine*, *35*(4), 396–401.

Yamamoto, K., Imamura, H., & Ando, J. (2018). Shear stress augments mitochondrial ATP generation that triggers ATP release and Ca^{2+} signaling in vascular endothelial cells. *American Journal of Physiology-Heart and Circulatory Physiology*, *315*(5), H1477–H1485.

Yuan, S. L., Matsutani, L. A., & Marques, A. P. (2015). Effectiveness of different styles of massage therapy in fibromyalgia: A systematic review and meta-analysis. *Manual Therapy*, *20*(2), 257–264.

Yüksel, İ., Akbayrak, T., & B., S. (2013). Konnektif doku masajı. In Yüksel, İ. (Ed.), *Masaj Teknikleri* (3. Baskı, ss. 82–353). Ankara: Asil Yayın Dağıtım Ltd. Şti.