

## Original Article

### Effects of massaging upper limb parts in different order on changing the level of blood circulation in the massaged area

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#### Abstract:

In contemporary physiotherapy, many massage schools and systems coexist, especially the Eastern system (Indian, Chinese and others) and many varieties of European system (Swedish, Finnish and others). Each system has its own techniques and methods of massaging. In addition, order in which different parts of a limb are supposed to be massaged is also discussed. In the classical contemporary Polish massage, the whole upper limb massage begins with the hand, whereas, in the classical Eastern European massage (Russian) massaging the upper limb begins with the shoulder girdle. In our work we wanted to examine to what extent the order of massaging individual parts of the upper limb can affect the degree of the massaged area temperature elevation, this way contributing to its better blood circulation. Thermovision, at the present stage of its development, gives us such an opportunity. As a result of the research, it turned out that the order of massaging the upper right limb and the adjacent neck area resulted in a higher positive difference in maximum, medium, and minimum temperature in comparison to the left upper limb massaged in the order traditional for the Polish massage (hand – forearm – shoulder). In our opinion, thermovision can be utilised to precisely substantiate the effectivity of classical massage therapy. Using this method enables to accurately assess temperature of different body areas and carry out dynamic measurements, which is also essential. This makes thermovision a good supportive method of assessing improvement in circulation of massaged body areas. We also think that precise assessment of improvement in circulation when massaging upper and lower limbs will allow us to clearly answer the question of which parts of limbs should be massaged first.

**Key words:** massage procedure – temperature distribution – thermovision

#### Introduction

Thermography, also known as thermovision, is a method of remote and contactless assessment of body surface temperature distribution. It is used in medicine and biomedical engineering not only for diagnostics, but also for cognitive purposes, because it allows to visualise the infrared radiation, invisible for human eye, thus, to obtain information on physiological and pathological processes in human body expressed by local and global temperature changes. Modern thermovision methods enable to determine temperature changes, including temperature values and spatial distribution, statistically and dynamically. Their main advantage is the fact that they are completely contactless and have no side effects for the patient.

This enables to perform multiple measurements with no negative effects on the patient (Ring E.F., H. McEvoy, A. Jung, J. Zuber, G. Machin, 2010; Ring E.F., K. Ammer, 2012). Number of currently realised scientific studies in medicine and related science fields involving thermovision, clearly indicates that thermovision meets with great interest. Passive and active thermography measurements are currently used in medicine (Ammer K., 1996; Rusch D., M. Follmann, B. Boss, G. Neeck, 2000; Rutkowski R., A. Straburzyńska-Lupa, P. Korman, W. Romanowski, M. Gizińska, E. Hurnik, R. Lorenz, 2011; Borevic N., D. Kolar, S. Grazio, F. Grubi, S. Antonini, I.A. Nola, Z. Herceg, 2011; Cholewska A., Stanek A., Sieroń A., Z. Drzazga, 2010; Dębiec-Bąk A., A. Skrzek, 2012; Ratajczak B., E. Boerner, A. Demidaś, K. Tomczyk, A. Dębiec-Bąk, A. Hawrylak, 2012; Bauer J., E. Boerner, H. Podbielska, 2014). In physical therapy, medical thermography is used as a tool to assess effectiveness of therapeutic procedures (Dębiec-Bąk A., A. Skrzek, 2012; Ratajczak B., E. Boerner, A. Demidaś, K. Tomczyk, A. Dębiec-Bąk, A. Hawrylak, 2012; Radziejowska M., Radziejowski P., Rutkowska K., 2020). In procedures of this type selected physical factors are used, e.g. low temperature, ultrasound waves, thermal waves etc. Parameters of stimuli are usually adjusted empirically or based on the level of sensory or motor reaction, that is why in physical therapy observation and registration of reactions during and after a physical procedure is crucial (Robertson V., A. Ward, J. Low, A. Reed, 2009). Thermovision is one of the most useful tools for that because it enables not only one-time assessment of procedure's effectiveness, but also tracking and assessing the effects of a series of treatments (Straburzyński G., A. Straburzyńska-Lupa, 2008; Rutkowski R., A. Straburzyńska-Lupa, P. Korman, W. Romanowski, M. Gizińska, E. Hurnik, R. Lorenz, 2011; Dębiec-Bąk A., A. Skrzek, 2012; Bauer J., E. Boerner, H. Podbielska, 2014; Bauer Joanna, MdNazmulHoq,

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John Mulcahy, Syed A. M. Tofail, Fahmida Gulshan, Christophe Silien, Halina Podbielska, and Md. Mostofa Akbar, 2020).

In our opinion thermovision will be also helpful in detailed justification of the effectiveness of the classical massage therapy. Despite the fact that massage has been known since antiquity as one of the effective therapies of traditional medicine, the modern system of classical massage developed in Europe relatively recently. A huge role in the development of the theory of therapeutic and health-improving massage played Per Henrik Ling, a Swedish physician, co-author of the so-called Swedish gymnastics. In the middle of the 19<sup>th</sup> century, in many European countries, theoretical elaborations describing therapeutic effects of a massage in the case of many conditions and symptoms started to emerge. A Dutch physician, Johan Mezger, has been considered the creator of the scientific Swedish massage (Magera L., 2017). One of the founders of the European School of Massage (Russian and German to a greater extent) was a Polish-born physician, Isidor Zabłudowski. His works greatly contributed to the development of scientific theory concerning massage influence on a human body in the territory of the former Russian Empire, thus, also in USSR (Zabłudowski Z.W., 1902). Contemporary physiotherapy includes a lot of massage schools and systems. First of all the Eastern system (Indian, Chinese, etc.) and many varieties of European systems (Swedish, Finnish, etc.). Each system has its own techniques and ways of massaging a patient, and the order of massaging limb parts is also discussed. While in the classical modern Polish massage, the whole upper limb massage begins with the hand (Prochowicz Z., 2015; Magera L., 2001; 2017), in the classical Eastern European massage (Russian) massaging the upper limb begins with the shoulder girdle (Birukow A.A., 2004; Fokin V.N., 2010). In our work we wanted to examine to what extent the order of massaging individual parts of the upper limb can affect the degree of the massaged area temperature elevation, this way contributing to its better blood circulation. Thermovision, at the present stage of its development, gives us such an opportunity.

The aim of this study was to assess temperature distribution after short-term classical massage of the upper limb and shoulder girdle carried out in different orders. The following massaging sequences were analysed: the traditional order (hand – forearm – upper arm – upper bundles trapezius muscle and neck) and the order used in the Eastern European massage (Ukraine, Russian) – starting the upper limb massage from the upper bundles of the trapezius muscle and neck, and then the upper arm – forearm – hand.

## Material & methods

### *Participants*

Our studies were conducted on a 21 years old male patient (BMI 24.96). Written consent to participate in the study was obtained from the patient before conducting the classical massage of the shoulder girdle and both upper arms and thermovision tests. Researchers also informed the patient on the benefits and risks resulting from participation in the study. Every part of the study was completely non-invasive. The study was granted an ethical approval by the Bioethical Commission of Kazimiera Milanowska College of Education and Therapy – by the resolution no. 006/2018/2019 of 10.05.2019.

### *Procedure*

Thermovision tests were conducted according to the ASTM E1213-97(2009) standards of the European Association of Thermology (Polish Committee for Standardization, 2010). The thermovision images were taken before and after the classical massage of the shoulder girdle and both upper arms. This enabled to assess temperature distribution on the upper limb parts massaged in different orders. The next step – interpretation of changes in the temperature distribution – allowed to extrapolate the level of circulation improvement. Techniques of classical massage were conducted according to the procedures described below.

Neck and upper parts of the trapezius muscle (musculus trapezius) massage sequence

Therapist's initial position – longitudinal to the patient.

Patient's initial position – sitting down with forehead resting on hands, chin maximally pulled down to the sternum.

1. Stroking the neck and shoulders with ten fingers from the occipital bone through the neck to the deltoid muscles, simultaneously (3–5 times).

2. Longitudinal stroking from the 12<sup>th</sup> thoracic vertebrae to acromions, simultaneously with both hands (3–5 times).

The therapist stands perpendicularly to the patient and massages distal side of the neck and shoulders (massaging the right side while standing on the left side of the patient).

3. Alternate stroking, with both hands, from the occipital bone to acromions (2–3 times).

4. Alternate stroking, with cross movements of one hand and zigzag-like movements of the other hand, from the occipital bone to deltoid muscles (2–3 times).

5. Compressing, with a heel of the right hand, the right side of the neck from the mastoid part of the temporal bone to acromions (2–3 times).

6. Cross compressing with outer edge of the hand (the 5<sup>th</sup> finger's side) (1–2 times).

7. Compressing, with finger pads of 3 fingers, the right side of the neck from the mastoid part of the temporal bone to acromions (1–2 times).

8. Cross kneading with one hand from the mastoid part of the temporal bone to acromions (3 times).

9. S-shaped kneading of upper parts of the trapezius muscle's myofascial tape (2–4 times, back and forth).

10. Kneading with a twist, using fingers, the neck muscles and upper parts of the trapezoid muscle (3 times).
11. Comb kneading from the occipital bone to acromions (1–2 times).
12. Kneading with a twist, complex (3 times).
13. Alternate stroking with both hands from the occipital bone to acromions (2–3 times).
14. Rubbing the occipital area with finger pads of both hands in circular motions (4–5 times).
15. Large sawing movements from the foramen magnum to the 7<sup>th</sup> cervical vertebra (7–10 times, back and forth).
16. Point rubbing, with finger pads of the 2<sup>nd</sup> and 3<sup>rd</sup> finger of one hand, from the occipital area to the level of inferior scapula angles (5–10 times).
17. Rubbing with circular motions of thumbs of both hands from the occipital area to the level of inferior scapula angles (4–8 times).
18. Rubbing around the spinous process of the 7<sup>th</sup> cervical vertebra, with circular motions of thumb pads (4–6 times).
19. Hacking and dorsal-phalangeal patting of shoulders and scapular area (10–15 seconds).
20. Stroking, simultaneously with both hands, the neck and shoulders from occipital area through the neck and shoulders to the deltoid muscle (2–3 times).

Shoulder joint massage sequence:

Initial position – patient sitting down, facing the therapist.

I – Anterior surface of the shoulder joint:

1. Concentric stroking 2–4 times;

Rubbing

2. Circular with finger pads 6–8 times;

a) Phalangeal 6–8 times;

b) With a heel of the hand 6–8 times;

c) With the outer edge of the hand 4–6 times;

1. Concentric stroking 2–3 times;

II – Posterior surface of the shoulder joint:– the same sequence – repeat techniques (from 1 to 3).

III – Upper arm.

Inner surface of the upper arm massage sequence

Stroking

1. Longitudinal 1–2 times;

2. Alternating 1–2 times;

Compressing (deep stroking)

3. Longitudinal 2–3 times;

4. Cross compressing with the outer edge of the hand (the 5<sup>th</sup> finger side) 1–2 times;

5. WITH THE HEEL OF THE HAND 1–2 times;

Kneading

6. With the entire hand and fingers 3 times;

7. S-shaped 4–6 times;

8. With finger pads 8–10 times;

9. Pinching with finger pads 4–6 times;

Rubbing

10. Phalangeal 2–4 times;

11. WITH KNUCKLES OF BENT FINGERS 2–4 TIMES;

12. LARGE SAWING MOVEMENTS 2–4 TIMES;

Tapping

13. With the outer edge of the hand 10–15 seconds;

14. With half-fists 10–15 seconds;

15. Vibration 5–10 seconds;

16. Alternate stroking 2 times.

Outer surface of the upper arm massage sequence

Initial position – the same – patient's arm in front of the head. Bolster under the elbow. Massage sequence – the same.

Elbow and forearm massage sequence (duration 2 minutes)

Patient's initial position – sitting down, hand on the massage table

Elbow

1. Circular stroking 2–4 times;

2. Rubbing with finger pads of the 2<sup>nd</sup> and 3<sup>rd</sup> finger 4–6 times;

Circular stroking 2–4 times;

Forearm (inner surface)

Stroking

1. Alternate 1–2 times;

2. PLANTAR SURFACE OF FINGERS, ALTERNATE 2–4 TIMES;

**Compressing**

3. With the heel of the hand 2–4 times;
4. With the outer edge of the hand 2–4 times;

**Kneading**

5. Circular with finger pads of one hand 8–12 times;
6. With thumb pads of both hands 4–6 times;
7. Phalangeal 2 times;
8. With a comb of bent fingers (comb kneading) 2 times;

**Rubbing**

9. With finger pads 2–3 times;
10. Phalangeal with circular motions 2–3 times;

**Tapping**

11. With half-fists 5–10 seconds;
12. Longitudinal stroking 1–2 times.

Move the hand and repeat the massage of the outer surface of forearm (the same sequence).

**Hand.** A hand is massaged with fingers and the palm. Stroking should be performed on the outer and then inner (palm) hand surface (4–6 times for each side). Rubbing: palm, every finger separately, outer side of the hand and wrist should be rubbed with a pad of a thumb – straight and circular movements (4–6 times for each part of the hand). The massage should be finished off with stroking the hand towards the heart (2–4 times).

**Data collection and analysis**

Thermovision tests were carried out using a thermovision camera Flir E6. These measurements were contactless and non-invasive and were taken before and after the classical massage of the right and left upper limb. Test results are presented in Fig. 1. The right upper limb was massaged in the following order: upper bundles of trapezius muscle and neck (EI 1) – upper arm (EI 2) – forearm (EI 3) – hand (EI 4); the left upper limb was massaged in the following order: hand (EI 5) – forearm (EI 6) – upper arm (EI 7) – upper bundles of trapezius muscle and neck (EI 8). The massage was finished off with intensive rubbing and stroking of both sides of the shoulder girdle and neck.

**Results**

The results of changes in temperature distribution after the massage of both limbs are presented in Fig. 1.

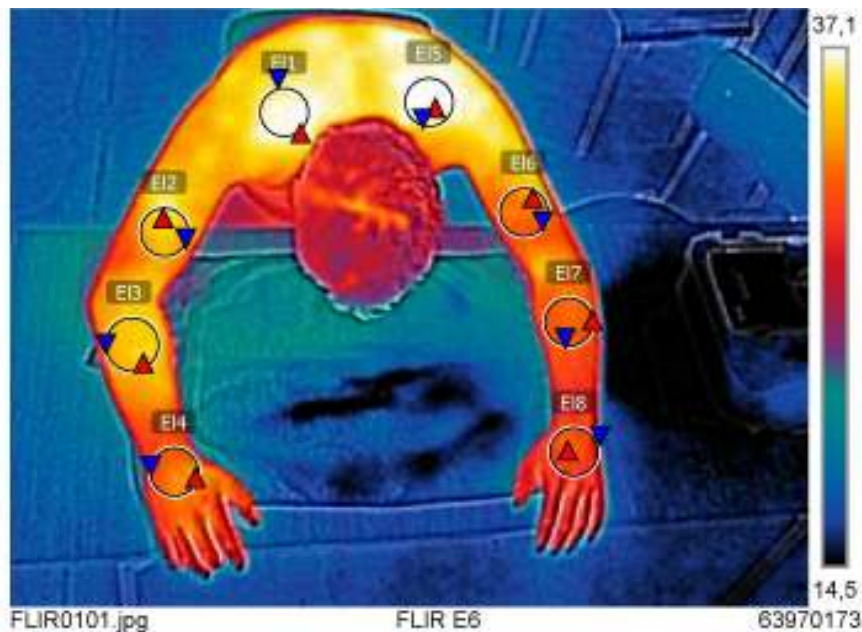


Fig. 1. Results of the changes in temperature distribution on upper limbs massaged in different orders: the right upper limb – from the neck and shoulder girdle to the hand, the left upper limb – from the hand to the neck and shoulder girdle.

Measurements Dt1, Dt2, and Dt3 characterise the temperature differences in the analysed area of the right (massaged 25 minutes earlier) and left shoulder girdle. It needs to be noticed that before taking the image both sides of the shoulder girdle were massaged using intense rubbing and stroking (2 minutes per each side), first the right side, and then the left side. The results showed that, although the right side of the shoulder girdle was massaged earlier, the temperature difference in these areas was insignificant, only the minimum temperature

significantly differed, but also to the benefit of the right side (+1.4°C) (Tab. 1). Measurements Dt4, Dt5, and Dt6 characterise temperature differences on the analysed areas of the right and left upper arm. The analysed area of the right upper arm, massaged earlier, showed significantly higher maximum, average, and minimum temperature (+1.9°C, +2.8°C, and +1.9°C, respectively). Measurements Dt7, Dt8, and Dt9 characterise temperature differences on the analysed areas of the right and left forearm. Observed tendency was similar to the one noticed on upper parts of limbs – the right forearm, that was massaged earlier, showed significantly higher maximum, average, and minimum temperature in comparison to the left forearm (+4.3°C, +3.8°C, and +2.7°C, respectively).

Table 1. Minimum, maximum, and average temperatures of the analysed areas of the right upper limb: upper bundles of the trapezoid muscle and neck (EI 1); upper arm (EI 2); forearm (EI 3); hand (EI 4); and the left upper limb: hand (EI 5); forearm (EI 6); upper arm (EI 7); upper bundles of the trapezoid muscle and neck (EI 8), and differences between the respective parts of both limbs (source: results of the measurements taken with the image presented in Fig. 1 – camera FLIR E6).

Measurements		
EI1	Max	37,4 °C
	Min	35,7 °C
	Average	36,7 °C
EI2	Max	36,1 °C
	Min	31,6 °C
	Average	33,9 °C
EI3	Max	35,2 °C
	Min	32,2 °C
	Average	34,0 °C
EI4	Max	32,5 °C
	Min	28,0 °C
	Average	30,9 °C
EI5	Max	37,4 °C
	Min	34,4 °C
	Average	36,9 °C
EI6	Max	34,2 °C
	Min	29,7 °C
	Average	31,1 °C
EI7	Max	30,9 °C
	Min	29,5 °C
	Average	30,3 °C
EI8	Max	30,5 °C
	Min	19,9 °C
	Average	28,8 °C

Dt2	EI1.Average - EI5.Average	-0,1 °C
Dt6	EI2.Min - EI6.Min	1,9 °C
Dt5	EI2.Average - EI6.Average	2,8 °C
Dt1	EI5.Max - EI1.Max	0,0 °C
Dt3	EI1.Min - EI5.Min	1,4 °C
Dt4	EI2.Max - EI6.Max	1,9 °C
Dt7	EI3.Max - EI7.Max	4,3 °C
Dt8	EI3.Average - EI7.Average	3,8 °C
Dt9	EI3.Min - EI7.Min	2,7 °C
Dt10	EI4.Max - EI8.Max	1,9 °C
Dt11	EI4.Average - EI8.Average	2,1 °C
Dt12	EI4.Min - EI8.Min	8,1 °C

Parameters	
Emissivity	0.6
Refl. temp.	34 °C

Measurements Dt10, Dt11, and Dt12 characterise temperature differences on the analysed areas of the right and left hand. Here, also the same tendency was noted – the right hand, that was massaged earlier, showed significantly higher maximum, average, and minimum temperature in comparison to the left hand (+1.9°C, +2.8°C, and +8.1°C, respectively).

### Conclusion

The process of development of massage as a scientific discipline and field of physical medicine over the years varied between different European countries. Different schools of massage have agreed only on one thing: in the segmental overall and drainage massage (Poland); and therapeutic, preventive, and recovery massage (Russia, Ukraine) limbs are to be massaged starting from their proximal to distal parts. Whereas in sports and classical massage most authors from both Poland (Prochowicz Z., 2015; Magiera L. 2017; Zbiorowski A., 2018) and Russia (Verbov A.F., 2002; Dubrovskyy V.I., Dubrovskaya A.V., 2014) prefer massaging limb parts in the opposite order – distal to proximal. However, in this case authors provided no explanation why this order should be used. In our opinion, these authors are under the influence of reports of the supporters of the Swedish massage. Authors working in the field of physical medicine and rehabilitation – Birukow A.A. (2004), Fokin V.N. (2010), and Vasichkin V.I. (2013) – believe that regardless of the purpose of the massage, whether it is therapeutic, preventive or

sports, the only order that should be used in limb massage is from their proximal to distal parts. The reason for that is the fact that it is necessary to start with opening vascular anastomoses and improve blood and lymph outflow from limbs. Such approach is also preferred in the Eastern massage system (Indian) (Tanushree Podder, 2005). Also, in our opinion, this order better suits the modern concept of physiological influence of massage on the human organism and reasonableness of using physical therapy methods in doses precisely adequate to organism's functional condition. The order with which the upper right limb and adjacent neck area was massaged resulted in higher positive differences between maximum, average, and minimum temperatures in comparison to the left upper arm massaged according to the order traditionally used in the Polish massage (hand – forearm – shoulder). It is also necessary to remember that the left upper limb was massaged later, after completing the massage of the right limb. Such changes in temperature distribution can indicate better and longer improvement of blood circulation in the right upper limb. Obviously, there is too little objective data available concerning the effectiveness of certain order of massaging the upper limb and additional comprehensive studies are necessary, but there is no doubt that when using the classical massage techniques and methods one needs to know exactly what are their effects on circulation of the massaged areas, how long the effects last for, and whether the initial assumption of using these techniques and methods suits the effects one wants to obtain.

In our opinion, thermovision can be utilised to precisely substantiate the effectivity of classical massage therapy. Using this method enables to accurately assess temperature of different body areas and carry out dynamic measurements, which is also essential. This makes thermovision a good supportive method of assessing improvement in circulation of massaged body areas. We also think that precise assessment of improvement in circulation when massaging upper and lower limbs will allow us to clearly answer the question of which parts of limbs should be massaged first.

**Conflict of interests – none.**

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