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The effect of Kinesiotaping to the skin temperature – Pilot study

Degree Programme of Physiotherapy

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Aim of this study was to research whether kinesiotape has effect to skin temperature. Subjects of this study were 32 asymptomatic students of Satakunta University of Applied Sciences, 20 females and 15 males. The exclusion criteria were: recent back pain or musculoskeletal diseases on back area skin irritations and diseases on taping site.

To assess the effect of kinesiotape all the subjects were taped with 30 cm taped from Superios Posterios Iliac Spine(SPIS) upwards to the ribcage. Before taping baseline image was taken, second immediately after application and last one 10 min after application. Suprailiac skin fold was measured to provide data of thickness of subcutaneous adipose tissue.

Based on the results kinesiotape does not have an immediate increasing effect to peripheral circulation when subject is standing. Mean change of skin temperature on taped side was  $-0,48^{\circ}\text{C}$ . Change was not statistically significant. Comparison of the results was done to the non-taped side that acted as a control side.

The further studies are needed to demonstrate the effect of kinesiotape to the circulatory system. Kinesiotape is seen to have an effect through motion. Thus exercise regimen should be included to study setting to determine whether it has an effect to results.

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## 1 INTRODUCTION

Kinesiotaping is widely used method of medical and sports taping. It has several indications of use e.g. different pain conditions, disturbances in muscular functioning and edemas (Kinesiotaping.fi,2013). Kinesiotape (KT) was developed by Dr Kenzo Kase in 1979. The KT has skin like qualities and acryl based glue (Kinesiotaping International Association, 2013).

In this thesis there are presented the results of the study that was carried out in fall 2013 and winter 2014 to determine whether there is increasing effect to the skin temperature on the taping site. The effect on lymph and blood circulation is seen to be one of the major pain relief methods of the KT due to decreased pressure to the nerve endings. (Kinesiotaping International Association, 2013).

Tape comes pre-stretched and is applied on the skin to specific shape. KT can stretched more before application and the degree of the stretch determines the pulling effect of the tape. On skin KT is trying to shrink back to the original length towards the origin of the tape (spot of the tape that was applied on the skin first and without stretch) simultaneously the wavy shape of the glue creates the lifting effect of the skin. This microscopical effect creates more space to the subcutaneous tissue and therefore decreases the peripheral pressure. This facilitates the lymph flow and lightens the resistance of blood flow. Decreased pressure allows vasodilation hence increasing peripheral circulation on taped area. In theory this is the basis of the increasing of circulation on taping site (Kåla & Kataja, 2011, 10)

Thermal imaging is widely used in different fields of applied sciences from the building industry to the medical science. All particles are radiating infrared radiation and the spectrum of the radiation is dependent of the thermal energy of the object, temperature. This is called radiation of the black object. This is utilized in thermal imaging (Korhonen & Someharju, 2002, 44, 89).

Studying the peripheral circulation the thermal imaging provides ideal method. Using digital thermal imaging the data is immediately available and differentiation ability

of modern equipment is more than enough. The blood is mostly water and has therefore thermal qualities of water (Tortora & Derrickson, , 690-691). Water can absorb large amount of energy and also emission of the energy to radiation is therefore easily detectable. Dry human skin has emissivity of 0,98 and can therefore be seen as long wave radiator which has maximum wavelength of 9,3  $\mu\text{m}$ , micrometer, on emission(Szenkuti, 2011,386). Calor and rubor are two of the signs of inflammation caused by increased blood flow through the vasodilation, increased blood flow to area(Cameron, 2009, 25). The increasing effect to circulatory system of taping can be seen as artificial inflammation due to desired effects. Therefore the increase of 0,7 C° is in this study setting considered as relevant.

At the moment the KT is gaining more and more popularity despite the fact that the evidence based knowledge of the fundamentals of KT is lacking. Study conducted by Kinesiotaping Association (1998) taping is effective in changing the blood flow for subjects with physical disorders. Taping effect is seen immediately (during 10 minute period). Also the increasing effect to blood flow measured with Doppler in healthy population it can be said that Kinesiotaping has no major adverse effect (Kenzo & Hazimoto, 1998)

Treatment method is relatively new and the application of the tape is easy “something extra” to the conventional therapy. The aim of this study is to provide small sample study that gives baseline data for comparison of the effect to the skin temperature after KT application.

## 2 THEORETICAL FRAMEWORK

As a treatment method the KT is relatively new and originates from 1970s Japan. Dr Kenzo Kase noticed that moving the skin has pain relieving effect. He wanted to know if same effect could be created with modality that would stay on skin and have the long term effect.(Kåla & Kataja, 2011, 8) Dr Kenzo developed the tape that was elastic enough and lifts the skin. According to the Kenzo KT can be used to: re-educate the neuromuscular system, reduce pain, optimize performance, prevent injuries and promote improved circulation and healing (Kinesiotaping International Association, 2013).

### 2.1 History of medical taping

The KT differs from the traditional medical taping in few ways. Where the sports tape is used to support and limit the movement the KT is applied to skin way that the normal movement pattern is either facilitated or inhibited. This facilitation/inhibition is created by the pulling effect of KT. The pulling effect is achieved by elasticity of the tape and wavy form of the glue applied on the tape. The tape shrinks towards the origo, the part of tape that was inserted on the skin first. (Bodytech, 2013, 6, Appelqvist, 2014)

Tape is hypoallergenic and the glue is latex free in most of the cases so it can be left on the skin from few days even up to one week. This property gives long lasting facilitative component to the patient (Bodytech, 2013, 8, Appelqvist, 2014)

Either traditional sports taping or KT are not excluding other method. They should be seen as complimentary methods to each other. (Bodytech, 2013, 3)

## 2.2 Differences in taping methods

The main difference is “traditional” sports taping and Kinesiotaping is that sports taping is seen as mechanical method with 5 main attributes: 1. protecting the joint, 2. limits the range of motion (ROM), 3. supports the joint, 4. corrects mechanically, 5. decreases circulation. Where the “sensory” KT prevents fatigue, has an effect to muscular function, decreases pain, increases ROM, optimizes and neutralizes. The approach is more or less opposite to the sports taping.

The psychological effects of the tape are also taken into consideration in the newest educational materials. The increased feeling of safety and body awareness are main psychological effects that are thought to have important role in good results in rehabilitation. (Bodytech, 2013, 6 )

The widely spread use and surprisingly good results in clinics have raised a discussion of the real effect of the KT. How great is the amount of placebo effect in this new treatment method and how much of the effects can be shown in scientific studies. Preliminary investigation has been done that show increasing peripheral blood circulation with exercise regimen, but the study could not show better result with kinesiotape than regular athletic tape. (Miller, M. et al, 2011)

## 2.3 Integumentary system

Integumentary system is a system that consists: the skin, hair, oil and sweat glands, nails and specialized nerve endings (Bodyguide, 2014). Role of this system is to maintain constant body temperature and provide information of the surroundings. Skin is the largest organ in the body. Over the most body it is only 1-2 mmm thick. The blood vessels are in the dermis layer of the skin. (Tortora,2009, 147-161, Niendested et al, 2006,93)

Skin functions as thermo regulator and blood reservoir. The vessels in dermis dilate or constrict based on the need of the homeostasis of rest of the body. 8-10% of the blood is carried in blood vessels of the skin on resting adult. The change can be detected as increased or decreased temperature and even color change of the skin. (Tortora, 2009 147-161)

#### 2.4 Blood circulation and thermoregulation

The thermal regulation of the body happens two ways firstly by sweating and secondly by adjusting the blood flow to the dermis (Tortora, 2009, 161). Body adjusts the temperature by controlling both loss of heat and production of heat. Main regulator is thermoregulatory center in Hypothalamus. It is affected mostly by temperature of the blood, but also by some extent the receptors of the skin (Niensted et al, 2006, 423, Haug et al 1995, 418). In rest the musculoskeletal system produces 20-30% of the heat in body. Relationship between surface area and volume of the body has an effect to heat production and heat loss. Heat generation increases when volume increases and when surface area increases the heat loss increases. When radius of object increases volume increases by radius squared but area increases on same portion with radius. Meaning that when radius increases the body is not losing the heat as effectively (Haug et al 1995, 412). The blood flow adjustment happens by either dilation of the vessels or constriction of the vessels. These reactions are known as vasodilation and vasoconstriction (Tortora, 2009, 161). The blood helps in temperature regulation as well as pH regulation (Tortora, 2009, 689).

#### 2.5 Thermal qualities of blood

Blood is a connective tissue. It has several components that build up a whole blood. The basic elements of blood are plasma, 55% of whole blood, and formed elements, 45% of whole blood. The plasma is mainly 91,5% water and it is single biggest element of blood. The water acts as solvent and suspends medium components of the blood. Blood has the thermal qualities of the water. Water has high heat capacity 4,19 kJ/K. It means that when the temperature of the water based solution changes



the absorbed/released energy is high. Physical base to this is number of hydrogen bonds in water. The water amount in blood protects the body from the external temperature changes and provides efficient way to maintain homeostasis of the system. Due to this high heat capacity the energy radiated from skin is easily detectable to infrared cameras. (Tortora & Derrickson, 2009 691, 40)

## 2.6 Thermal imaging

Thermal imaging or thermography is recording the emitted infrared radiation of a certain object. Infrared detector of thermal camera translates the intensity of radiation to thermal data that is used to produce digital images in real time. In these images different colors represents different temperatures. Primary use of thermal images is to establish the surface temperature distribution of an object. (Infradex Oy, 2014)

There are two different main types of imaging kits: measuring and non-measuring. Measuring equipment are used e.g. in condition inspections and anticipatory maintenance of industry. Non-measuring equipment is usually used in surveillance or search equipment. Thermal imaging equipment works on range from -40-1500 °C. In order to thermal images be accurate the emissivity factor of surface and back ground radiation (temperature) has to be known. (Infradex Oy, 2014) After the thermal imaging was released to non-military purposes 1958 the applications for it has quickly grown and recent development of imaging equipment for example availability of portable equipment and increased accuracy and points measured per image, has enabled even more applications for imaging (Ring & Ammer 2012, R43,R37)

### 3 THERMAL IMAGING IN MEDICAL SCIENCES

There are basically two main applications for thermal imaging in medical sciences: firstly diagnostic test and secondly outcome measure for clinical trials and researches (Ring & Ammer 2012, R37)

The imaging of the thermal variation is relatively easy and when used in the field of medical sciences there are few advantages: 1. Thermal imaging is non-invasive inspection method of the skin temperature giving idea of ongoing pathological processes (Szenkuti et al 2011, 385), 2. Degree of bilateral thermal variation that is clinically significant is easily detectable because  $0,7^{\circ}\text{C}$  signs ongoing pathological process 3. Digital thermal imaging gives instant data to analysis without long waiting and data is easily converted to numerical form to make long term follow up bases. (Szenkuti et al 2011, 386) The thermal imaging is used for peripheral circulation studies through the skin temperature changes at least in Raynaud's phenomenon studies in which the thermal recovery is studied (Ring & Ammer 2012, R40). At the moment there is no comprehensive data to which compare the result of each imaging set up e.g. for hand thermography there is more than 20 reported methods. The small size and portability of modern imaging kit opens even more clinical applications e.g. in operating theaters and post-operational treatment (Ring & Ammer 2012,R36-40).

#### 3.1 Heat transfer – Second law of thermodynamics

The second law of thermodynamics states that in closed system the entropy, degree of chaos always increases. In the thermal point of view this means that when two objects with different temperatures are placed close to each other difference in thermal energy, temperature, seeks to equalize, to decrease difference in temperature. Thermal energy can be transferred three ways: conduction, radiation and heat transport. The relevant heat transferring way to this study is radiation. (Korhonen & Somerharju 2002, 44, 26) All particles radiate infrared beams to surroundings and that is called thermal radiation. All particles also absorb radiation. Difference in thermal energy decides whether particle gains or loses thermal energy (Haug et al 1995, 415) Main principles of radiation are following: radiation is electromagnetic

radiation emitted by every object, warmer the object is greater the thermal emission is. Radiation transfers energy that is absorbed by other objects. This is another physical principle, conservation of energy (first law of thermodynamics). (Korhonen & Somerharju 2002, 44, 26)

This radiation is recordable with thermal imaging devices and converted to the color spectrum representing thermal value of the radiation. Warmer the emitting body higher the energy contain of the radiation. The infrared radiation is created by oscillation inside the molecules. (Korhonen & Somerharju 2002, 87)

#### 4 RESEARCH QUESTIONS & AIM

Aim of this thesis is to determine whether there is a temperature change on skin after KT application.

The study also aims to find out whether there is relationship between change of temperature of the skin and skinfold thickness. This data could provide information whether the thermal imaging results are straight comparable to each other.

Research questions are:

- 1) Is there a temperature change on skin surface after application of kinesiotape
- 2) Is there correlation between the tissue structure and magnitude of detected change

## 5 METHODS

In this study the data is collected using thermal imaging camera Optipris OPT-PI400-023-T1500 and the variance on the temperature is read from the pictures. The data is placed on the excel spread sheet and the changes between each point in time is calculated. The non-taped side of the back works as a control group and give data for comparison. Differentiating ability of the thermal camera is 80mK (Opris Pi Brochure, 2009).

### 5.1 Skinfold

Skinfold measurement is way of measuring the thickness of under skin fat tissue. Subject is standing while measurement is taken. The fold is lifted between index finger and thumb and measuring tool is placed on the middle of distance form edges. Readings are recorded after two seconds. Measurement is carried out every time on the right side of the body and repeated three times. The result is mean value of three measurements. Skinfold measurement can be used to predict the fat percentage of person with prediction equation. This is not done in this study. Skinfold measurement is used only to provide information of the tissue structure of the subjects. Skinfold used in this study is supra iliac skinfold. It is horizontal fold superior to the iliac crest on the side of the subject.

The results of skinfold measurement are not completely comparable between tools and measurers. Also different distribution of the adipose tissue makes interpersonal comparison useless. (Keskinen et al 2004, 48-50)

### 5.2 Defining taping site

The KT is applied to the back of the client unilaterally. Specific place of the tape is determined by the bony land marks. The base of the tape (5cm) is applied on the Posterior Superior Iliac Spine, SPIS. From that place 30 cm long strip of tape is applied on the skin without the stretch. The correct taping is presented in Fig 1. The

tape is applied in line with the spine on top of the erector spine. By using the bony land mark and predetermined tape strip the taping application is standardized in the region of interest, ROI

ROI is determined by bony land marks: below SPIS and iliac crest, medially spine, above 12<sup>th</sup> rib and laterally the ROI continues till the end of skin. In this area the taping has similar skin lifting effect that is not dependent of the length of the back. The area of back is also chosen since the taped area should be hairless or shaved before taping. Back area in most of the cases is hairless enough for taping without shaving the area. This makes the protocol faster. (Grönholm, personal communication 29.11.2013).



Fig 1. Example of taping (Grönholm, 2013)

### 5.3 Infrared camera and properties

Infrared camera is device that captures the infra-red radiation and interprets the results to the color scaled digital images camera used in this study is: Optris OPT-PI400-023-T1500. The infrared cameras are used to detect the distribution of surface temperature over an area. The scale of temperature in which the thermal imaging is possible is wide approximately  $-15^{\circ}$  to  $1500^{\circ}\text{C}$  (Vierinen, 1998). On the table below there are some emissivity factors. In order to get reliable data the emissivity factor of

KT has to be determined. Definition of factor is done in piloting with comparison of contact thermometer and infrared image in which the emissivity factor can be manipulated (Weckström, 2002).

Table 1. Some emissivity factors (Weckström, 2002)

<b>Material</b>	<b>Emissivity factor (<math>\epsilon</math>)</b>
<b>Steel</b>	0,35
<b>Steel, oxidated</b>	0,85
<b>Stainless steel</b>	0,30
<b>Stainless steel, slightly oxidated</b>	0,40
<b>Stainless steel, oxidated</b>	0,80
<b>Copper</b>	0,06
<b>Copper oxidated</b>	0,80
<b>Aluminum</b>	0,13
<b>Aluminum, oxidated</b>	0,40
<b>Brick</b>	0,85
<b>Asphalt</b>	0,85
<b>Skin</b>	0,99
<b>Water, depth over 50 mm</b>	0,95
<b>Wood</b>	0,85

## 6 PLAN

The building theoretical framework for the study was started in spring 2013 and carried out during the summer and early fall. Piloting and implementing study were done in late fall 2013 and January 2014. Data analysis was conducted on January 2014, thesis was presented in February 2014. Report was finalized during summer 2014.

### 6.1 Subjects & Inclusion/exclusion

Sample of this study was drawn from Satakunta University of Applied Science. Sample size was 40 persons. Person enrolling needed to be student in SAMK, over 18 years old, a volunteer and asymptomatic.

The sample was planned to contain 20 males and 20 females. All the participants were volunteers, and with no history of musculo-skeletal problems on the back area and their skin was intact. Subjects are recruited through email inquiry to the physiotherapy students, so in the study there is no randomization and already existing population is used as of sample of convenience

Participants filled pre-questionnaire including health questions and written consent (APPENDIX 1). In which the questions of recent back pain, skin problem and smoking was asked.

#### 6.1.1 Contraindications and precautions for taping

There are only few absolute contraindications for KT and some precautions that have to be considered before KT application. Absolute contraindications are: 1. open wound, 2. on top of the fragile skin, 3. On top of the lymph cyst, fistulas and radiogenic fibrosis, 4. On top of the malignancy, 5. Area where blood clots are suspected, 6. Infected areas, 7. first and last week of pregnancy in lumbar taping techniques (Appelqvist, 2013; Kåla & Kataja, 14)

It is also recommended to take into account: diabetes, decreased skin sensation, renal diseases, significant untreated heart dysfunction, acute asthma, high blood pressure, swelling in internal organs, guiding the swelling to already swollen area and skin under constant pressure e.g. in sitting or lying (Appelqvist, 2014).

## 6.2 Protocol

Aim of this thesis was to introduce small scale study of the effects of KT to skin temperature. The protocol is repeatable and can be applied in larger sample. Each client filled the pre questionnaire concerning their overall health and living habits that might have an effect to results. The data was anonymous and the questionnaire was connected to the corresponding pictures by using sequential numbering.

The protocol included: questionnaire, acclimatization for five min, thermal image before KT application, application of tape (technique explained below) immediate thermal image after application and thermal image ten minutes after application. Between the images subjects were seated without the shirt on. Example images are presented below in Fig 2 and Fig 3.

In the space the room temperature was constantly followed and recorded every 30 minutes. Shades should be closed to eliminate the direct sun light and reflections and the space was as close to breeze free space as possible to minimizing other forms of thermal energy transportation.





Fig 2. Subject pre-taping



Fig 3. Subject 10 minutes after taping

### 6.2.1 Taping technique

Used taping technique is similar to unilateral neurosensory technique for sacrospinalis. In the study length of the tape is predetermined, 30cm, and it is applied to the skin without any tension to create maximal skin lifting effect. Desired hypothetical skin lifting effect is presented in Fig 4 below. (Grönholm, 2013).

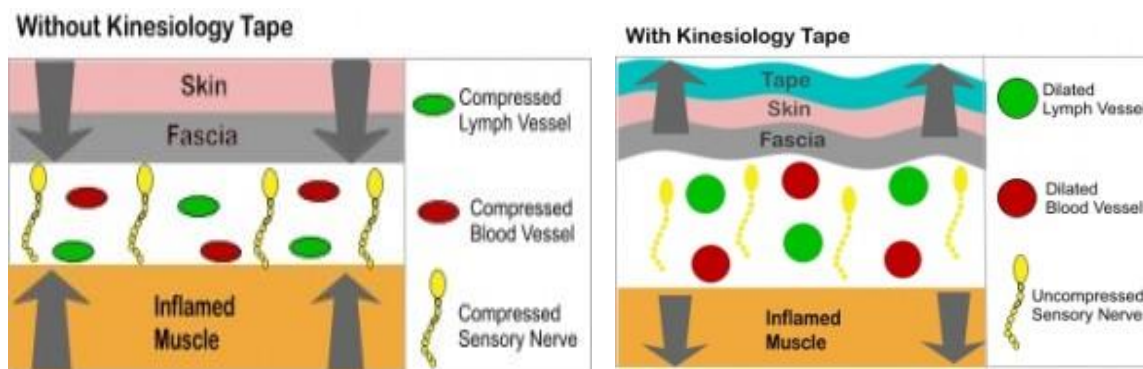


Fig 4. Desired skin lifting effect of Kinesiotape (Matrix physio, 2013)

Taping is carried out following five steps:

1. Cleaning the skin with water and drying it
2. After acclimatization superior posterior iliac spine (SPIS) palpated and five cm base of tape applied
3. Pre stretch of tape is released, participant does maximal trunk flexion
4. KT is carefully lowered to skin without tension and rubbed to skin
  - Rubbing is done four times from SPIS up
5. Pt extends back to neutral position

The taped area should be hairless and skin should be cleaned with warm water before application of therapeutic taping in this study the cleaning the skin can be left out since the focus of the study is in short term effects and especially on thermal effect. If site is wiped with water before taping it might have an effect to temperature of skin before and after taping. If performed skin cleaning could interfere with tape contact and temperature recording. (Grönholm, 2013).

### 6.2.2 Imaging kit setup

Thermal imaging kit was borrowed from the laboratory of technical campus. It included Optris OPT-PI400-023-T1500 with high sensitivity 80mK (Optris Pi Brochure, 2009). Whit camera came one laptop computer with the run software for camera. Data recording another laptop computer was used.

Thermal camera was placed on tripod on marked spot on the classroom floor. Camera was leveled. One meter distance was measured and marked on the ground with tape to mark the place where subject is standing while imaging is done. Height of the camera was adjusted according the subjects height on the way that area seen on the screen was from under the SPIS to the scapulae to ensure that whole ROI is in the picture.

Areas from which software was measuring mean temperature was set from to be on each side from PSIP to over the upper end of tape. This set up gives mean temperature on area, additionally the spot temperature on tape and correspondent spot on non-taped side was measured to get confirming data for mean temperature.

### 6.3 Piloting the study

The procedure was piloted in 16th December 2013, with the similar population as the subjects on the study and teachers of the faculty of well fare. The role of teacher was to be an objective observer, give feedback of protocol overall. Based on the feedback and the time estimation per measurement the more careful time table for the implementation was done.

Kinesiotapes were provided by Bodytech Oy. Guidance to tape application was given before the piloting by Bodytech instructor Mr. Marko Grönholm. Guiding for imaging kit use was given by Ms. Tommiska Janika who is a laboratory technician of Satakunta University of Applied Sciences.

In piloting phase the emissivity factor of the tape is studied. It is carried out with thermal camera and contact thermometer. It is done by comparing the reading of the thermometer to the reading of the thermal camera and adjusting the emissivity parameter of the camera (Tommiska. 2014)

#### 6.4 Analysis of method

The results are analyzed with paired T-test. Paired t-test is used to focus the analysis to the differences between pairs of measurement (Domholt, 2005, 321). It tells the ratio of the differences between the groups to the differences within the groups. This test method tells whether the difference in studied factor is explained by protocol or the individual difference between the subjects. When variability explained by independent variable is larger than unexplained variability the statistically significant difference can be identified (Domholt E, 2005, 310). In the settings of studies including human also level which is clinically relevant change has to be identified. This identification can be based on earlier studies or clinical experts on the studied field. (Domholt 2005, 307)

To carry out the t-test the hypotheses has to be placed. Zero hypotheses states that there are no differences between the groups and other hypotheses states that there is difference between the groups. For this setting the  $H_0$ =there is no difference in temperature between taped and non-taped side after KT application. Alpha level was set to the level of 5%. When two tailed probability is less than preset alpha level the statistically significant difference is found (Domholt, 2005, 320). To carry out the t-test the studied pool has to be normally distributed, when the number of subjects exceeds 30 there is no need for testing the normal distribution (Taanila 2012, 16).

The collected data was interpreted with the Optris software and translated to Excel spread sheet. The analysis was done with Tixel9, SPSS 18.0 and Microsoft Excel software.

The correlation between the skinfold and change of temperature is calculated with Tixel9 software calculates the correlation coefficient and gives a numeric value as a result. Strength of correlation was defined: <0,25 little if any, 0,26-0,49 weak, 0,5-0,69 moderate, 0,7-0,89 high, 0,9-1,00 very high.. (Domholt 2005, 354, 358)

## 6.5 Considerations for analysis

In the thermal imaging study the acclimatization continues through the study period, five minutes of acclimatization and the time elapsed to the study methods and ten minutes of waiting for the last picture. This means that skin temperature is decreasing all the time and therefore the change in temperature is compared between sides.

## 7 RESULTS

The definition of emissivity factor for Kinesiotape was done to blue tape of Bodytech. The factor was found out to be 0,99 that is similar to the value of skin so the taped area and the skin are comparable from one image. Thermal imaging was done in class room which temperature was followed through imaging sessions, mean room temperature was 21,8 °C ( $\pm 0,4$ ). 35 subjects (n=35) enrolled to the study 20 females and 15 males, from those one female did not come on agreed time, one female subject had to be excluded due to fever and one male subject due to operated back. Population was normally distributed, tested with Kolmogorov-Smirnow and Shapiro-Wilk. Anthropometric data of included subjects are found in table. Data analysis was conducted with 32 subjects (n=32). Mean age of participants was 24,5 ( $\pm 4,83$ ) years ranging from 20 to 41.

Table 2. Anthropometric data of subjects

	Male	Female	Sum
<b>N</b>	14	18	32
<b>Mean Age</b>	25,2(±6,2)	23,9(±3,6)	24,5(±4,9)
<b>Skinfold</b>	15,4(±4,7)	17,9(±6,4)	16,8(±5,8)

Mean of the pre-taping temperature was on the taped side 33,26 (±0,99) °C and non-taped side 33,11 (±0,94)°C. Table below presents the mean temperatures in different times with minimum and maximum values from each point of time.

Table 3. Mean changes of temperature in °C on side with tape application

Variable	n	Mean	SD	Min	Max
<b>Taped side</b>					
Pre-temperature	32	33,29	0,99	31,3	35,3
Temperature immediately after tape application	32	33,11	0,86	31,4	34,9
Temperature 10 minutes after tape application	32	32,9	0,82	31,1	34,3
<b>Non-taped side</b>					
Pre-temperature	32	33,15	0,93	31,1	35,5
Temperature immediately after tape application	32	33,14	0,95	31,2	35,6
Temperature 10 minutes after tape application	32	32,87	0,9	30,8	34,3

Temperature variance between sides was  $0,15^{\circ}\text{C}$ . Immediate change on after kinesiotape application was  $-0,19 (\pm 0,39)^{\circ}\text{C}$  on taped side and  $0,02 (\pm 0,02)^{\circ}\text{C}$  on non-taped side. Change after ten minutes was  $-0,38 (\pm 0,57)^{\circ}\text{C}$  on taped side and  $-0,29 (\pm 0,48)^{\circ}\text{C}$  on non-taped side. There is a change in temperature but the difference on sides is not statistically significant ( $p=0,162$ ). The change in temperature also is not clinically significant since it did not exceed the preset limit of clinical significance  $0,7^{\circ}\text{C}$  (Szenkuti et al,2011 ,386). Only one subject exceeded the limit of clinical significance. KT seems to not have an effect on skin temperature on such short time. It seems that despite the taped side the back cooled down on similar rate mean difference being  $-0,12^{\circ}\text{C}$ , where the side difference pre-taping was  $0,14^{\circ}\text{C}$ .

Table 4. Change in temperature after 10 minutes

<i>Variable</i>	<i>n</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
<b>Taped side change after 10 min</b>	32	-0,40	0,57	-1,60	0,50
<b>Non-taped side change after 10 min</b>	32	-0,28	0,48	-1,30	0,90
<b>Difference in changes after 10 min</b>	32	-0,12	0,46	-1,30	0,80

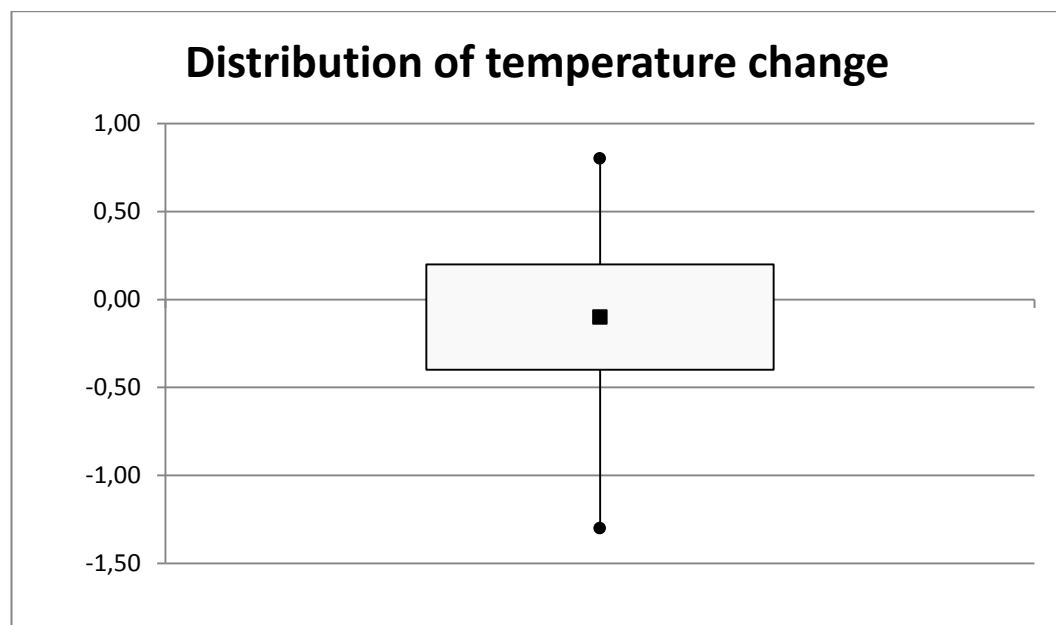


Chart 1. Change after 10 minutes compared (taped side-non taped side)

In skinfold measurements the studied group was relatively homogenous mean being 16,8mm SD 5,8. Male subjects having 2,5 mm lower thickness value of supra iliac skinfold. The skinfold did not seem to have varying effect on the area of the back. There seems to be low correlation between skinfold thickness and temperature change  $r=0,26$ . (Domholt, 2005, 358) Scatter diagram below demonstrates the relationship between skinfold and temperature change after ten minutes.

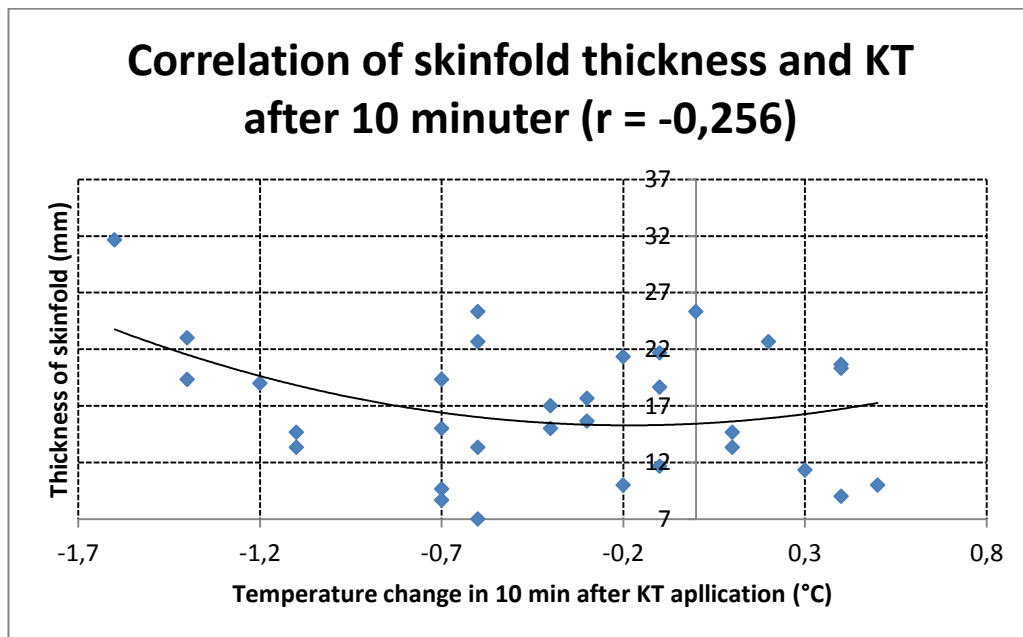


Chart 2. Correlation between skinfold thickness and change in temperature

## 8 DISCUSSION

Aim of the study was to determine whether the Kinesiotape has increasing effect to skin temperature. Studying the skin temperature allows noninvasive evaluation peripheral circulation. Secondary research question was whether the subcutaneous adipose tissue has an effect to the detected change. Based on the results kinesiotape alone does not have effect on skin temperature and thickness of skinfold has low negative correlation to detected infrared radiation. In the study settings of this thesis effect of kinesiotape was studied without supporting movement. It is rather seen that most of the functions that kinesiotape has it has in connection with movement. This study seems to indicate that KT has no immediate effect to skin temperature with



healthy immobile subjects. Thickness of supra iliac skinfold has weak correlation ( $r=-.26$ ) to measured skin temperature. Result points to direction that thicker the measured skinfold smaller is the detected change in skin temperature over time. This means that if study is carried out with larger population and more anthropomorphically varied subjects it has to be taken in to consideration when calculating the results.

Despite the fact that statistical significance was not reached the study results implicates that even with larger number of participants the clinically significant change would not be reached with mere taping. Since only 1% ( $n=1$ ) of the subjects exceeded the limit for clinical significance. It would be interesting to see if increasing time to several hours would make the difference in result since KT can be on skin even up to several days.

### 8.1 Reliability of the study

Despite the widely spread use there is small base of scientific evidence in which the use of tape can be referred to. Most of the studies are case studies or they have fundamental faults in study design that prohibits the results to be generalizable to the overall population. The most critical fault in the study designs are the lack of randomization and control group in study designs i.e. poor methodological quality (Basset, K., Lingman, S. & Ellis, R., 2010). To study done on 2010 there were on ly 3 reports that filled the criteria of Basset et a(2010) and were available for review, criteria were randomized controlled trials (RCTs) and quasi-experimental design studies focusing on use of KT in treating musculoskeletal problems. The conclusion was that at the moment there is no clinically significant knowledge of benefits of kinesiotape application and there is clear need for further research. (Basse et al, 2010)

Thermal imaging can be seen as easily accessible way to study effects to peripheral circulation. Whole study was conducted with one person and standardization of the procedure was seen sufficient. Relatively long immobile period between images two and three had greater effect to skin temperature than applied KT. During this period

the acclimatization continues and inter-subject variability can be great. This means that beginning and end temperatures are not comparable between subjects, but the individual change has to be calculated and that compared.

Pre questionnaire that subjects filled before the study was narrow and focused on the contraindications for taping. Questionnaire should take more widely into consideration also living habits that might have an effect to circulation. Also the subjects should come to thermal imaging from similar daily routine. The circulatory response can vary depending what subject has done before imaging. These facts should be taken into consideration when carrying out possible further research on this subject. The protocol was once piloted before the actual data collection to achieve fluent pattern to carry out imaging. Second piloting should have been done to see whether all the corrections from first piloting are done and are they enough to ensure standardized protocol.

Subjects of the study were recruited through email from the students of degree program of physiotherapy. This means that also most of the subjects had idea how kinesiotape is said to have an effect to circulatory system. In my opinion this increases the possibility of placebo effect. Also more careful recording of subject data would have provided more base for analysis. For example the collecting height and weight information from subjects would have provided tool for more careful assessing effects of anthropometric factors for the result.

In the analysis there was noticed that there were few outliers in the data. These outliers could have been removed from the pooled data and carry out the analysis again to see whether there is difference. A decision was made to leave outliers out of analysis since the difference was minor compared to limits of clinical significance, scale of  $-0,2^{\circ}\text{C}$ .

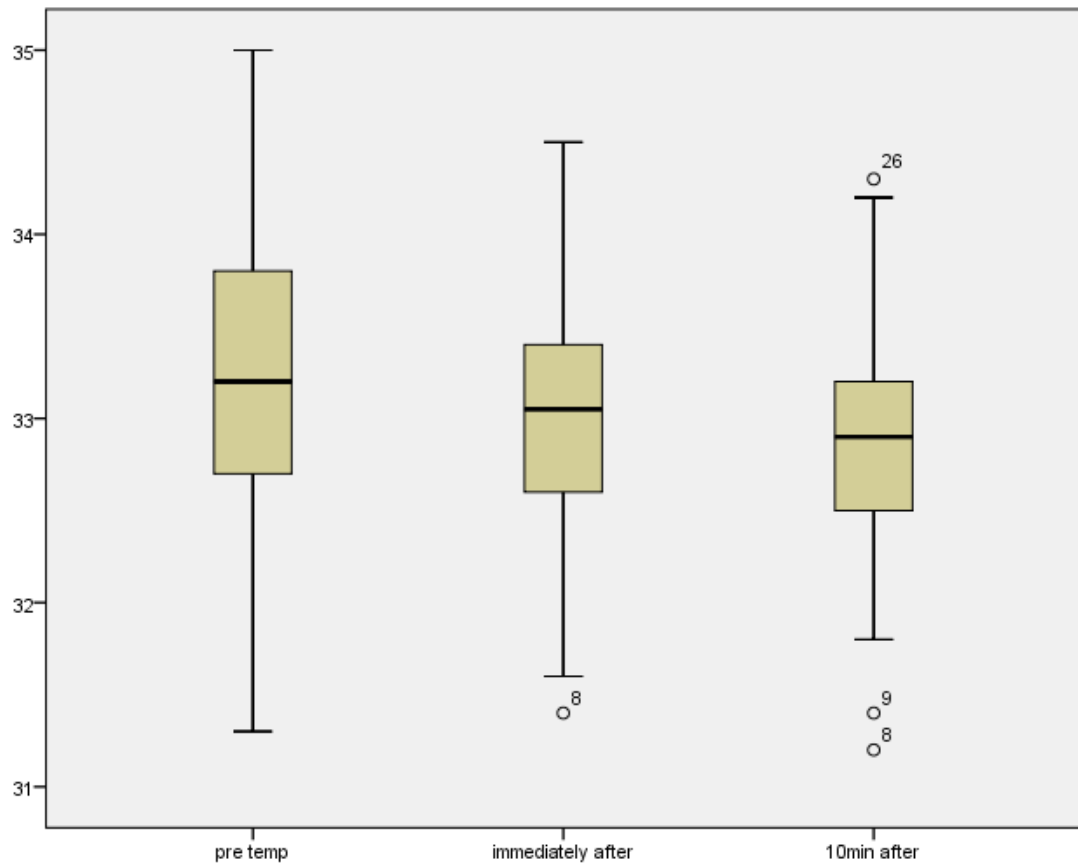


Chart 3. Outliers immediately after KT application and 10 minutes after KT application. Y- axis being temperature (°C)

My thesis study had same difficulties as reported by Basse (2010). Sample size was small to reach statistically significant data, subjects were young and active and sample of convenience was used. Also no exact sample size was calculated beforehand. Also more anthropometric data should be collected, minimally weight and height.

## 8.2 Considerations for further studies

There is clear need of further studies on the mechanisms of function of kinesiotape. Both in healthy population and non-healthy population. Based on the study I carried out circulatory effect seems to be less than expected even the thinking of mechanisms of function is increasingly elsewhere. It would be interesting to add to my study setting some exercise regimen activating the area that subjects would be doing for 10 minutes with or without the tape and see whether there is difference

between groups or even individuals when they are taped or non-taped. Other fascinating topic could be studying the placebo effect of kinesiotape. If there is found recordable effect for KT it could be studied in way that subjects are unaware of the tape that is used to tape them and see if similar effect can be achieved with normal athletic taping. The other possible area for further studies with kinesiotape is the lymph flow. The effects for edema could be studied over water over flow measurements with similar protocol as used in this study.

## 9 CONCLUSION

Temperature change of the skin was detected but the changes were on the scale that clinical significance is tenuous. Mean value of change stayed also remarkably under the level of clinical significance,  $0,7^{\circ}\text{C}$  being  $-0,4^{\circ}\text{C}$ . Negative result indicates that even with the KT acclimatization continued and skin temperature decreased on result of acclimatization. No clinically or statistically significant change by application of KT was found in this thesis study. The result differs from the Doppler study conducted by Kenzo and Hashimoto(1998) that studied changes in peripheral blood flow. Reliable research data is still needed to confirm or reject the assumption of increasing effect of kinesiotape.

Skinfold thickness showed to have weak negative correlation with temperature change ( $r=-,256$ ). Showing when the skinfold is thinner the detected infrared radiation is greater. More careful documentation of the anthropometric qualities is needed to gain reliable answer to this research question.

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## APPENDIX 1

Etukäteiskysely lämpökamera tutkimukseen osallistuvilla

Lue kysymykset ja valitse vaihtoehdoista sinulle sopivin.

1. Sukupuoli

mies

nainen

2. Onko teillä verenkiertoelimistö sairauksia?

ei

kyllä,

mitä? \_\_\_\_\_

3. Onko teillä tuki –ja liikunta elimistön sairauksia?

ei

kyllä,

mitä? \_\_\_\_\_

4. Onko teillä selän alueella ihoongelmia?

ei

kyllä,

mitä? \_\_\_\_\_

5. Tupakoitteko?

en

kyllä, montako savuketta päivässä \_\_\_?

Vastauksenne käsitellään luottamuksellisesti.

Olen tietoinen testaustavastaa ja osallistun siihen omalla vastuullani

Porissa \_\_\_\_\_

---

## Preliminary questionnaire for thermal image study

Choose the most suitable option

1. Gender

Male

Female

2. Do you have diseases affecting to blood circulation?

no

yes,

what? \_\_\_\_\_

3. Do you have any musculoskeletal problems?

no

yes,      what?

4. Do you have skin diseases that affect to back area?

no

yes,

what? \_\_\_\_\_

5. Do you smoke?

no

yes, how many cigarets per day \_\_\_\_?

Your answers will be confidential.

I am aware of testing method and I voluntarily take part to the research process

In Pori \_\_\_\_\_

\_\_\_\_\_