Clinical Observations

Effects of Different Scraping Techniques on Body Surface Blood Perfusion Volume and Local Skin Temperature of Healthy Subjects

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Objective: To study the mechanism and effects of different scraping techniques on body surface blood perfusion volume and local skin temperature of healthy subjects and to provide a baseline for microcirculation and energy metabolism for the evaluation of the therapeutic effects of scraping.
Methods: Changes of the local blood perfusion volume and skin temperature of healthy subjects before and after applying different scraping techniques were observed with a laser Doppler imager combined with an infrared thermographic device and the resulting data was analyzed with imaging and processing software for statistical analysis.
Results: Local blood perfusion volume and skin temperature all increased after both reinforcing and reducing scraping techniques. The value of blood flow 60 and 90 min after the reducing technique was significantly higher than that after the reinforcing technique (P<0.01), while the skin temperature increased after both techniques but was not significantly different between the two (P>0.05).
Conclusion: Scraping can significantly improve the local blood perfusion volume, increase skin temperature and promote local blood circulation and metabolism of tissues.

Keywords*: scraping; manipulating techniques; blood perfusion volume; temperature; microcirculation*

The history of scraping therapy is closely related to *Bian* Stone needling and blood-letting puncturing techniques recorded in the book *The Yellow Emperor's Inner Canon* and can be traced back to more than 2000 years ago.[1] Modern scraping therapy is an external therapy with wider indications based on traditional scraping therapy[2] Though clinically it has been widely applied, few people have studied its actions and mechanism.

Commonly used scraping techniques include reinforcing, reducing and a combination of both techniques. Reinforcing technique is characterized by gentle and slow scraping. Reducing technique is characterized by strong and quick scraping. Reinforcing technique aims to be "gentle but not floating: unsettled and mild; reducing technique, "strong but not inflexible: full and heavy."

In this study, with the assistance of laser Doppler imaging and an infrared thermographic device, changes in local blood perfusion volume and skin temperature of healthy subjects during reinforcing and reducing techniques of scraping therapy were observed and analyzed. Data was collected to objectively evaluate microcirculation and energy metabolism to explore the efficacy of scraping therapy.

METHODS

Apparatus and Materials

1. Laser Doppler perfusion imager

A PeriScan PIM II laser Doppler perfusion imager (PERIMED Company, Sweden) was used with a laser wavelength of 670 nm, NR scan mode, step size of 3 mm, scan accuracy set at Medium, and image element size of 40 mm × 40 mm. Using LDPI 2.5 Image Software. This apparatus was connected to a computer to record, store, analyze and process the blood flow image of the body surface as well as the laser blood flow image and visual image of the examined areas. Through mild power laser radiation and the Doppler effect generated by the frequency shift of blood flow at the body surface, the changes in blood perfusion volume were measured and studied.[3] When the two images were compared, the distribution of blood flow and its corresponding relation to different scraping techniques and body surface location could be analyzed.

2. Infrared thermographic device

A WP-1 type of infrared thermographic device with a temperature resolution of 0.08 °C was adopted for thermal images. Based on infrared radiation photographic principles, the apparatus was connected to a computer to convert thermal energy information into

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temperature data and to display and record the distribution and changes of body temperature in colorful images. The 3.41 version of image processing software was used to process and analyze the temperature data of the images.

3. Materials

Scraping tools: buffalo horn scraping plates; Media: Scraping oil (both supplied by Beijing Jinlong Kangfu Scraping Cupping Research Institute, Beijing, China).

Subjects

Eleven healthy human subjects (6 males; 5 females) aged 20–40 years were selected after physical examination.

Environment

Research was conducted in a laboratory maintained at 25–27°C without direct sunlight or infrared radiation sources. The laboratory was isolated from other indoor and outdoor ventilation.

Areas for Observation

Scraping area: The skin over the spine was scraped from C_7–T_{10} along the bladder meridian of the right side, along with the erector spinal muscle covering an area 5–6 cm wide and 17 cm long.

Infrared thermal images were made at the skin over the spine from C_7–T_7. Laser Doppler blood flow images were made at both the left and right sides of the back spine (reinforcing technique on the left and reducing technique on the right), at 4.5 cm lateral to the spinous process of the 4th thoracic vertebra on either side.

Procedure

1. Process

In a laboratory environment, the subject was asked to sit quietly for 15 min with their shirt off and their back exposed from neck to waist, to adapt to the room temperature and become calm. Infrared temperature images of the patient in sitting position and laser Doppler images of the selected areas of the spine with the patient in a prone position were collected. The doctor then began scraping with a reinforcing technique on the left side of the back until the skin became slightly red, and with reducing technique on the right side of the back until the skin turned dark red and purple-red. Infrared temperature images and laser Doppler images of the scraped areas were collected immediately (0 min), and at 15 min, 30 min, 60 min, and 90 min after scraping.

2. Method of collecting the infrared thermal images

The subject sat erect, 1.5 m from the infrared thermographic device, which was calibrated by a round calibration image. The thermal imaging camera system was connected to a computer which recorded the images. Temperature data was collected and processed by the thermographic processing procedure.

3. Method of collecting blood flow charts by laser Doppler

The subject was placed in a prone position and blood flow charts of the selected scraping areas of the back on the left and right sides were collected by a blood flow meter connected with the computer. LDPI 2.5 imaging software was used for recording, analysis, processing and storage of the images.

4. Temperature and blood perfusion data collection and statistical analysis

According to the thermal images and blood flow charts, combined with visual images of the observation areas recorded, the temperature and blood flow values in selected areas were collected by infrared thermography and laser Doppler perfusion imaging and processing software, respectively, and statistical analysis was performed with SPSS 17.0 software (SPSS Inc.).

RESULTS

After scraping according to the routine technique, the subjects felt a warming sensation at the scraped area, accompanied by a slightly painful but relaxed and comfortable feeling. The skin became slightly red with the mild (reinforcing) scraping technique on the left side of the back; and became dark red and purple-red after scraping with strong (reducing) technique on the right side. Subcutaneous hyperemia and oozing hemorrhage were present in the scraped area.

Changes of Blood Perfusion Volume after Scraping with Different Techniques

Laser Doppler measurement of regional blood flow indicated that the blood flow in the scraped areas increased significantly with both techniques, compared with before scraping. perfusion value (PU) values of local blood flow increased from 0.468 ± 0.010 to 0.911 ± 0.182 when reinforcing technique was applied. PU values of blood flow increased from 0.485 ± 0.068 to 1.072 ± 0.199 when reducing technique was used. Both techniques doubled the value compared to before scraping (Figure 1, Figure 2 and Table 1).

Changes of the Skin Temperature after Different Techniques of Scraping

Skin temperature increased significantly within 90 min of both scraping techniques. The average temperature increased by more than 1°C. The temperature increased quickly after scraping, and the warmth spread gradually through the local area (Figure 2, Figure 4, and Table 2).

Figure 1. After scraping along the urinary bladder meridian of the two sides of the back, the local skin became slightly red with the reinforcing technique (left side) and dark red with the reducing technique (right side). The laser Doppler images showed that both techniques increased the blood perfusion volume; a) before scraping; b-f) 0, 15, 30, 60 and 90 min post-scraping.

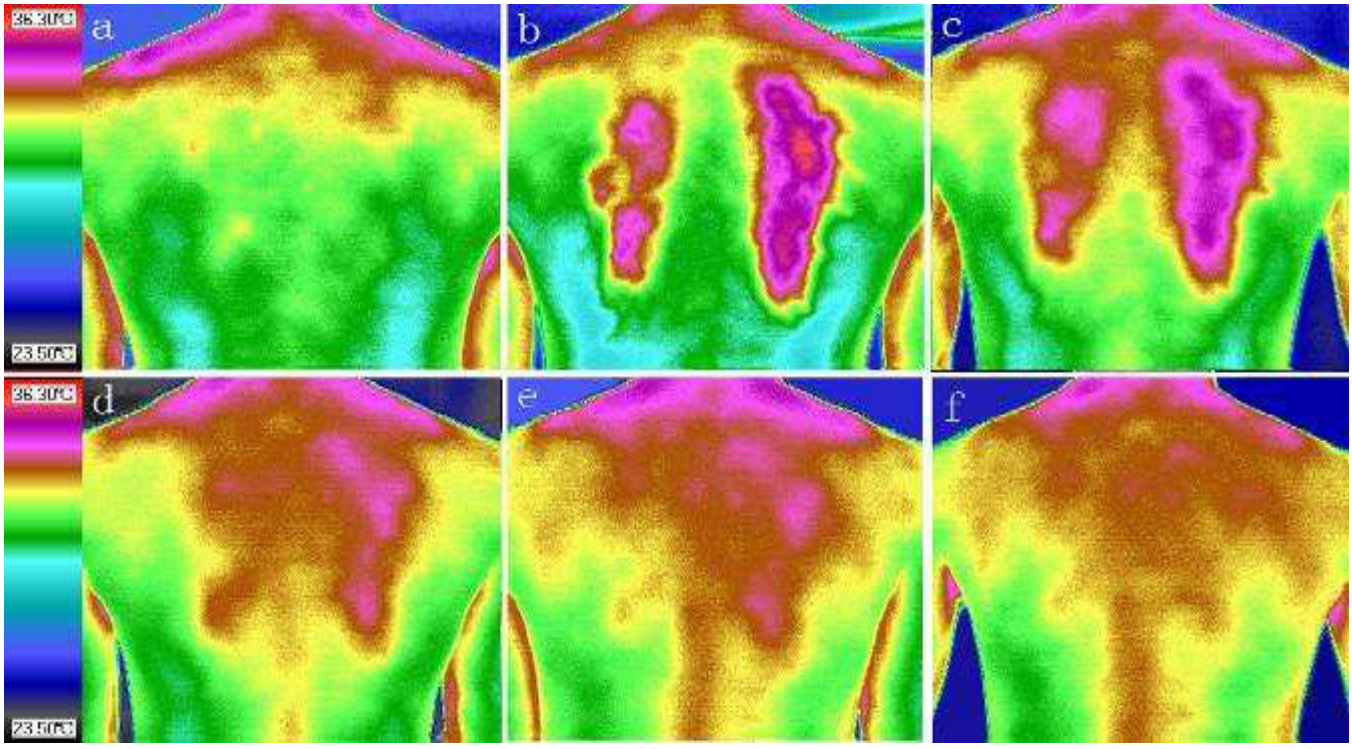

Figure 2. The infrared thermograph showed that the skin temperature of the two sides of the back increased remarkably after scraping. The increased temperature area of the reducing technique side (right) was larger than that of the reinforcing technique side (left). The local increased skin temperature spread to nearby areas after 15 min of scraping. Temperature increases lasted for more than 1 hour. a) before scraping; b-f: images 0, 15, 30, 60, and 90 min after scraping.

Effect of Scraping Techniques on Body Surface Blood Perfusion Volume and Infrared Temperature

Statistical analysis was made for the temperature and blood flow value of the selected areas using image processing software with the infrared thermograph and laser Doppler imager, respectively.

The blood volume in the reducing areas at all measured points in time was higher than that in the reinforcing areas, with a statistically significant difference (P<0.01) at 60 and 90 min after scraping (Table 1 and Figure 3).

There was no statistically significant difference in infrared temperature before scraping and at any point after scraping (P>0.05) (Table 2 and Figure 4).

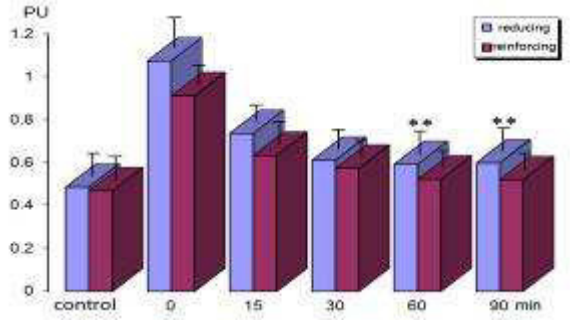

Figure 3. Changes of blood perfusion volume with reinforcing technique and reducing technique.

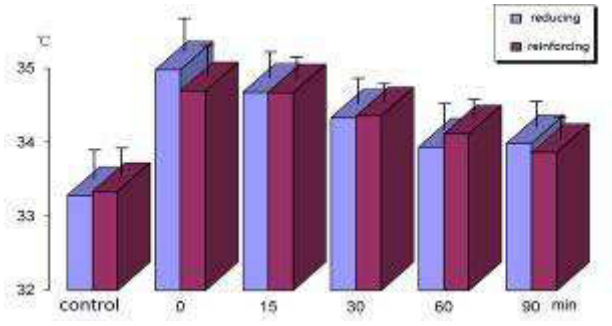

Figure 4. Changes of temperature with reinforcing technique and reducing technique.

Table 1. Mean perfusion value (PU) of skin after reinforcing and reducing techniques in different periods of time, n=11, ($\bar{x}$ ±s)

PU	Reinforcing area	Reducing area	P value
Before scraping	0.468±0.010	0.485±0.068	P>0.05
0 min	0.911±0.182	1.072±0.199	
15 min	0.633±0.102	0.736±0.208	
30 min	0.573±0.064	0.610±0.081	
60 min	0.522±0.061	0.591±0.057	P<0.01
90 min	0.520±0.048	0.598±0.063	P<0.01

Table 2. Mean infrared temperature (°C) of skin after reinforcing and reducing scraping techniques in different periods of time, n=11, ($\bar{x}$ ±s)

(°C)	Reinforcing area	Reducing area	P value
Before scraping	33.337±0.765	33.281±1.046	P>0.05
0 min	34.692±0.767	34.974±0.817	
15 min	34.667±0.774	34.672±0.669	
30 min	34.353±0.763	34.327±0.9676	
60 min	34.109±0.843	33.934±0.693	
90 min	33.862±1.026	33.982±0.843	

DISCUSSION

In recent years, scraping therapy has been more widely applied in treating frequently encountered diseases in clinical practice with quite good effects.[4] However, the research on its mechanism is limited. With the assistance of a laser Doppler imager and an infrared thermographic device, the clinical efficacy and mechanism of scraping therapy can be carried out in relation to its effect on microcirculation.

Blood perfusion volume is one of the most important parameters in the study of microcirculation, as it reflects its functional condition.[5] In this experiment, the changes in blood perfusion volume and temperature of the skin were displayed by images after different scraping techniques, providing an understanding of the influence of scraping on the microcirculation of the skin surface. Under natural conditions, in a stable environment, the skin surface microcirculation remained relatively constant.[6] The Doppler images and quantitative data analysis showed that the two different scraping techniques both increased the skin surface blood perfusion volume significantly. Moreover, the local blood perfusion volume remained at a high level for a longer period of time after the reducing technique than after the reinforcing technique. The difference was especially notable between 60–90 min, indicating that scraping not only produced a transient local vascular response but also activated the regulative functions of the body. When the microvascular circulation system, regulated by the general vegetative nerve system, was hurt by a noxious stimulus, a vasoconstrictor reflex occurred.[7] Both reinforcing and reducing techniques of scraping increased the blood perfusion volume immediately, indicating that this type of stimulation was not perceived as noxious.

Scraping stimulation produced an interaction between the blood perfusion volume and skin temperature. Both reinforcing and reducing techniques increased the local skin temperature significantly for more than 60 min with a gradual spread over the area (Figure 2). The spreading area of increased temperature on the reducing side was remarkably larger than that of the reinforcing side, but the temperature value resulting from the two techniques was not significantly different. There was a clear correlation between blood perfusion volume and temperature. When the temperature increased, blood

perfusion volume increased; when the temperature decreased, blood perfusion volume decreased accordingly. The local thermal effects would lead to microvascular expansion, thereby activating local blood circulation, improving oxygen supply and promoting both internal and external environmental changes of the tissues and cells so as to invigorate the local metabolism.[8,9] Changes of the tissue temperature were inevitably associated with changes of the energy metabolism, and energy metabolism is the most basic feature and necessary condition of life activities.[10,11]

The 56th chapter of *Plain Questions* explains that "the 12 meridians and collaterals are distributed in their relevant cutaneous regions." The operating sites of scraping are cutaneous regions of meridians and collaterals and this method of treatment stimulates the collaterals of the body surface.[12] Skin is the largest organ of the body. It protects the body from being invaded by exogenous pathogens and at the same time regulate the body's temperature and keeps it relatively constant. It acts as a barrier. The regulation of skin temperature mainly depends on the local blood perfusion volume and metabolism of the local tissues.[13] In natural conditions, it is directly associated with the temperature in the deeper tissues, reflecting the functional state of vegetative nerve.[14,15]

This study showed that the increased blood volume of the local tissues and rising of the local skin temperature caused by scraping could effectively improve local microcirculation and tissue metabolism and that the reducing technique was able to keep the blood perfusion volume at a high level for quite a long time. Scraping therapy functions by removing obstructions in the meridians and collaterals, activating blood circulation, removing blood stasis, regulating the joint structures and functions and promoting the recovery of chronic diseases, and has a quite good effect in the treatment and prevention of diseases, especially those marked by pain.[16] All of these effects result from the improvement of local microcirculation and tissue metabolism. However, further research should be carried out to find out whether such stimulation can affect the changes of the microcirculation in deeper tissues or regulate the other systems of the body, and to explain the correlation between points and meridians.

REFERENCES

1. Yang JS, Wang YY. Basic concept of "Sha" (oozy bloody spots) and the history of scrapping. Chin J Basic Chin Med (Chin) 2007; 13: 104-106.
2. Wang YY, Yang JS, Study on the Comparison between ancient and present scrapping therapies. J Chin Med (Chin) 2010; 51: 274-277.
3. Zhang D, Wang SY, Ma HM, Li SY, Observation on the efficacy of acupuncture by laser Doppler imaging techniques. Shanghai J Acupunct Moxibust (Chin) 2004; 23: 37-40.
4. Wang YY, Yang JS. Study on the indications and prospects for scrapping therapy. Chin Acupunct Moxibust (Chin) 2009; 29: 167-171.
5. Hu WW, LI GL, Guo Y. Research on Correlations between Meridians and Microcirculation. Global Chin Med (Chin) 2010; 3: 231-233.
6. Ma HM, Zhang D, Li SY, Wang SY, Sun ZB. Analysis on distribution of healthy subjects' back temperature and infrared thermal images. Biomed Eng Clin Med (Chin) 2006; 10: 238-241.
7. Wang GJ, Zhang YQ, Wang RH, Ding YL, Tian YY, Huang T, et al. Experimental Study on the effect of Electric thermal Bian Stone on the blood perfusion of the dorsum hand of the local skin. Tianjin J Tradit Chin Med (Chin) 2009; 5: 382-384.
8. Liu XY, Lv YN. Measurement for skin surface temperature after massage therapy. Sichuan Tradit Chin Med (Chin) 2007; 25: 101-103.
9. Guan ZH, Xu J. Effects of thermal needling on the nail fold microcirculation of protrusion of lumbar inter vertebral disc. Chin acupunct Moxibust (Chin) 1996; 26: 233-235.
10. Xu JS, Zheng SX, Pan XH, Hu XL, Sa ZY. Effects of electric acupuncture on microcirculation perfusion and infrared radiation track of the body surface. J Fujian Coll Tradit Chin Med (Chin) 2010; 20: 13-15.
11. Xu JS, Pan XH, Sa ZY, Hu XL. Observation on electric acupuncture for the changes of blood perfusion volume of microcirculation in deeper tissues along the Du meridian. Global Chin Med (Chin) 2010; 4: 270-272.
12. Zeng SJ. Preliminary Study on the principles of scrapping therapy along the meridians of TCM. Sichuan Tradit Chin Med (Chin) 1999; 17: 54.
13. Zhang D. The application of infrared thermal imaging technology in the research of acupuncture theory and meridians. Chin Acupunct Moxibust (Chin) 2004; 24: 37-42.
14. Zhang D, Wang SY, Wang YC, Fu WX, Ma HM. Measurement for temperature in the deeper areas in different parts of the body surface. Beijing Biomed Eng (Chin) 2001; 20: 288-291.
15. Zhang D, Wang SY, Ma HM, Li SY, Qu XX. Study on infrared thermal imaging technology for examination and evaluation of exercise training effect. Sports Sci (Chin), 2008; 28: 37-41.
16. Yang JS, Wang YY. Preface of Chinese Standard Scrapping Therapy. Publishing House of the 2nd Military Medical University; 2011: 5.

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