Effect of Kinesio Taping and Low-strength Exercises on Blood Pressure and Peripheral Circulation

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Summary: In order to examine the effects of Kinesio Tape on blood pressure and circulation, pressures were recorded after 70 minutes in the supine and resting position. Then the tape was applied to the lower thigh, and pressures were recorded after 70 minutes and the results were compared. In addition, they were compared with the 20-minute exercise at 30% exercise strength using a bicycle ergometer, before and after application of Kinesio Tape. The application of Kinesio Tape to the lower thigh showed no significant change in local peripheral circulation compared with the un-taped supine resting condition, but it was found that local peripheral circulation at the site of attachment of Kinesio Tape to the lower thigh could be enhanced by combining with low-strength exercise.

Clinical research report or Basic research report:

“Objectives”: In studying the effects of applying Kinesio Tape, a lot of clinical effects such as reduction of joint and muscular pains, prevention of a decrease in muscle strength and an increase in the range of motion of joints have been reported. There have been, however, few reports about its effects on the peripheral circulation. In this study, therefore, the effects of Kinesio Taping and low-strength exercise on the peripheral circulation were examined.

“Methods”: Three types of measurements were conducted on 6 healthy young subjects. Measurement-1: Supine position and resting for 70 minutes. Measurement-2: Supine position and resting for 70 minutes after application of Kinesio Tape. Measurement-3: Supine position and resting for 30 minutes after conducting the exercise of about 30% strength for 20 minutes after application of Kinesio Tape after resting for 20 minutes. As an index of peripheral circulation, the acceleration plethysmogram index (APG index) obtained by integrating the plethysmogram 2 consecutive times was used.

“Result and discussion”: 1. In measurement-1, the heart rate, systolic pressure and pressure pulse showed no change, but the diastolic pressure increased significantly, and the APG indices at the fingertip and the right toe decreased significantly. It indicates that the peripheral circulation was exacerbated by resting for a long time.
2. In measurement-2, the diastolic pressure increased significantly as observed in the measurement-1. The APG indices at the fingertip and the left toe (with Kinesio Tape attached) showed no significant change. In the comparison of the APG indices between the right and left toes, that at the right toe partly showed a significantly high value.
3. In the comparison of the APG indices between the right and left toes, the right toe showed a significantly higher value.
4. In measurement-3, the APG index at the right toe showed no significant change, the APG indices at the finger tip and the left toe (with Kinesio Tape attached) partly showed a significantly high value in the recovery period. In the comparison between the right and left toes, the left toe (with Kinesio Tape attached) showed a higher value than the right toe, which was not significant.
5. In the comparison of 3 conditions, no significant difference was seen in any item. These results indicated that use of Kinesio Tape might influence the changes in peripheral circulation. It suggests that the signal transduction from the periphery to the brain can be activated by application of Kinesio Tape and that the peripheral circulation can be changed through the autonomic nerves (Mori 2002).

It is necessary to further examine the effects of slight continuous local compression, from application of Kinesio Tape, on the peripheral circulation. By conducting a low-strength exercise while attaching Kinesio Tape on the lower thigh, the possibility of improvement of the peripheral circulation in the left toe (with Kinesio Tape attached), which can make a program for improvement of the peripheral circulation easier for obese people, the elderly and those with diseases requiring much time to improve the peripheral circulation by exercise.

1. Objectives

Taping has been used as a preventive tool into the sporting world and medical practice as well as in daily life. Tapes include inflexible white tapes and flexible elastic tapes, which have been used according to their respective applications. Kinesio Tape is one of the latter types, and has been reported to be effective in treating various conditions, including reduction of joint pain and muscle pain, prevention of a decrease in muscle strength and an increase in the range of motion of joints. The basis of its effectiveness is that the skin is lifted by attachment of the tape, that the circulation is improved by flowing of the lymph fluid into the space and that the function of muscles is increased by stimulation to the skin. There have been, however, few reports about its effects on the peripheral circulation. In this study, therefore, the effects of Kinesio Taping and low-strength exercise on the peripheral circulation were examined.

2. Methods

The following 3 types of measurements were conducted, on different days, on 6 healthy university students (3 males and 3 females) aged 21 to 22 years (Mean S.D.:21.8±0.41 years old)

Measurement (1): Supine position and resting for 70 minutes; Measurement (2): Supine position and resting for 70 minutes after attachment of Kinesio Tape; and Measurement (3): Supine position and resting for 30 minutes after conducting the exercise of about 30% strength for 20 minutes after attachment of Kinesio Tape after resting for 20 minutes.

Method of attachment: the base of the tape was attached to the ankle using a gastrocnemial muscle taping method; the both edges of the Y-part of the tape were adhered to the posterior surface of the lower thigh so as to cover the gastrocnemial muscle while the ankle joint was inflected to the maximum. We used Kinesio Tex Tape, 5.0 cm in width, manufactured by Kinesio Taping Co., Ltd.

The exercise was conducted using a bicycle ergometer (Model EC-1600) manufactured by Cat Eye Co., Ltd. set between 50 and 59 rotations/minute. The strength of exercise was established as the heart rate corresponding to 80% strength of the HRR using a Karvonen's method. The exercise time was adjusted to increase the load gradually in order to reach the respective heart rate specified in the initial 8 minutes and to adjust the load as needed to maintain the specified heart rate for subsequent 20 minutes.

The blood pressure, heart rate and acceleration plethysmogram were recorded in the supine position at intervals of 5 minutes. The heart rate was determined using a digital automatic sphygmomanometer (HEM-770A Fuzzy) manufactured by Omron Corporation. Blood pressure was determined using a mercury sphygmomanometer and an electronic sphygmomanometer, and the systolic pressure and diastolic pressure were determined in the right brachium by employing the Swan's first point and the fifth point, respectively.

The measurement at rest was conducted four times (R5 to 20) at intervals of 5 minutes, and the measurement after exercise was conducted at intervals of 5 minutes - from 5 minutes to 30 minutes of recovery (Rec 5 to 30) in the supine position. The blood pressure and heart rate during exercise were determined on a saddle at intervals of 5 minutes (Ex5 to 20) after W-UP for 3 minutes. The heart rate during exercise was determined from the left ear lobe using an ear sensor attached to the bicycle ergometer.

The acceleration plethysmogram was determined in the tip of the left second finger and the right and left thenars using a BC checker manufactured by Future Wave, Inc. The acceleration plethysmogram was obtained by integrating the plethysmogram twice and has been reported as a method for evaluation of the peripheral circulation. Recently, it has become possible to determine the acceleration plethysmogram value at various sites other than the fingertip, due to development of a near-infrared light diffusion transmitting sensor, and the value can be reported at sites such as the head, upper limbs and lower limbs.

The waveform of the acceleration plethysmogram has 4 inflection points labeled 'a' to 'e' and has been analyzed by classification of waveforms and indexation. The waveforms are classified into seven types, 'A' to 'G', according to their relation to the 'a' to 'e' points. Waveforms A and B show good peripheral circulation commonly observed in youth and athletically trained persons, C type shows gradual decrease in the peripheral circulation, and D to G types show bad peripheral circulation,

commonly observed in the elderly and people with circulatory diseases. Indexation shows the ratios of the height at the b to e points to that at the a point (b/a ratio, c/a ratio, d/a ratio and e/a ratio, Figure 1).

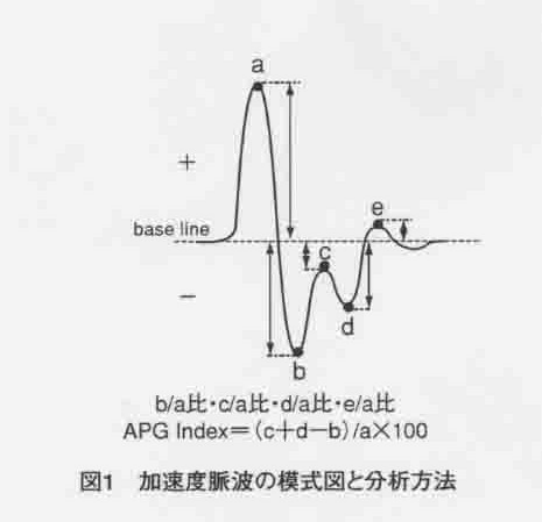

Figure 1. Diagram of acceleration plethysmogram and its analytical method

The acceleration plethysmogram index (APG index) was calculated as a comprehensive index by the formula shown below. In this study, the acceleration plethysmogram index (APG index) was used.

Acceleration plethysmogram index (APG index) = (-b+c+d)/a×100

All the results were expressed with the mean ± standard deviation. As the value at rest, the mean of R5, R10, R15 and R20 (hereinafter referred to as the value at rest) was employed. The value at rest and the values at the respective times of measurement were compared by paired student-t test.

For comparison of the intergroup difference, one-way analysis of variance and unpaired student-t test were conducted, and the level of less than 5% was considered a significant difference.

3. Results

1. Changes in the measurements (1) and (2)

In measurement (1), the heart rate, systolic pressure and pulse pressure showed no change with resting, but the diastolic pressure increased significantly at R30 ($p<0.05$), R45 and R60 ($p<0.01$). The APG index at the fingertip and the right toe, on the other hand, decreased significantly at R40 ($p<0.01$), and that at the left toe showed no significant change. As for the APG index at the right and left toes, those at the left toe at R25 and R40 were significantly higher than that at the right toe ($p<0.05$).

In measurement (2), the heart rate, systolic pressure and pulse pressure showed no change with resting, but, as observed in measurement (1), the diastolic pressure increased significantly at R30, R50, R55, R60 and R70 ($p<0.05$). The APG index (with Kinesio Tape attached) at the fingertip and the left toe, on the other hand, showed no significant change with resting. The APG index at the right toe, however, showed significantly high values at R25, R30, R35, R40 and R55 compared with those at rest ($p<0.05$). As for the APG indices at the right and left toes, that at the right toe showed a significantly high value only at R60 compared with that at the left toe ($p<0.05$).

In measurements (1) and (2), there was no significant difference in the heart rate, systolic pressure, pulse pressure, diastolic pressure, the APG indices (with Kinesio Tape attached) at the fingertip and the left toe. As for the APG index at the right toe, however, significantly high values were observed at R25 ($p<0.05$), R80 ($p<0.05$), R70 ($p<0.05$), R35 ($p<0.01$) and R40 ($p<0.001$) in measurement (2).

2. Changes in measurement (3)
(Hereinafter, R5 to R20 were considered the values at rest, Ex5 to Ex20 were considered the values during exercise, and Rec5 to Rec80 were considered the values during recovery.)

The heart rate during exercise increased significantly at Ex5 to Ex30 compared with that at rest ($p<0.001$), the systolic pressure increased significantly at Ex5 ($p<0.05$), Ex10 ($p<0.05$), Ex15 ($p<0.01$) and Ex20 ($p<0.01$) compared with that at rest, the pulse rate increased significantly at Ex5 ($p<0.01$), Ex10 ($p<0.01$), Ex15 ($p<0.01$) and Ex20 ($p<0.001$) compared with that at rest. The diastolic pressure, on the other hand, decreased significantly at Ex10 ($p<0.05$), Ex15 ($p<0.01$) and Ex20 ($p<0.01$) compared with that at rest. The values after exercise returned rapidly to those at rest.

The APG index at the right toe showed no significant difference, but that at the left toe (with Kinesio Tape attached) increased significantly at Rec25 compared with that at rest ($p<0.05$). That at the fingertip increased significantly at Rec15 compared with that at rest ($p<0.05$). As for the APG indices at the right and left toes, that at the left toe (with Kinesio Tape attached) showed a high value but showed no significant difference.

3. Comparison among the measurements (1), (2) and (3)
In the comparison among 3 groups (at recovery from exercise loading), there was no significant difference in the heart rate, blood pressure and APG indices (Figure 2).

Supine and resting
Tape group
Tape + Ex. Group

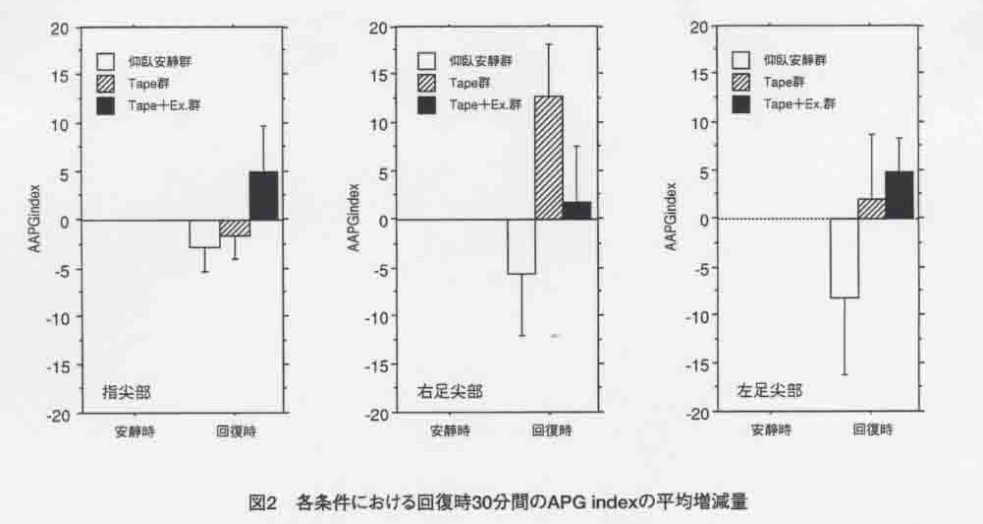

図2　各条件における回復時30分間のAPG indexの平均増減量

Fingertip　　Right toe　　Left toe
At rest　During recovery　　At rest　During recovery　　At rest　During recovery

Figure 2. Mean change in the APG index for 30 minutes during recovery under various conditions

4. Discussion
1. Comparison between the value in supine position/at rest and that during attachment of Kinesio Tape
In supine position and resting for 70 minutes and during attachment of Kinesio Tape, the heart rate, systolic pressure and pulse rate showed no significant change with time, but the diastolic pressure showed a significant increase. It is assumed that this change was caused by decreased peripheral circulation in association with a supine position for a long time. As for the change in the acceleration plethysmogram, however, those at the fingertip and the toes in supine position and resting partly showed a significant decrease, but the APG indices at the left toe with Kinesio Tape attached and the fingertip showed no significant change. On the contrary, the APG index at the right toe without Kinesio Tape attached showed an increase.

These changes indicate that decreased peripheral circulatory functions after long-term supine position and resting are observed even in young, healthy subjects. It is considered attributable to a decreased muscle pumping effect due to lack of constriction and relaxation of muscles for a long time and a decrease in the amount of perfusing blood in the vein due to decreased respiratory movement and pulmonary pumping.

Similarly, it is assumed that attachment of Kinesio Tape has an effect on a the peripheral circulation. It suggests that signal transduction from the periphery to the brain is activated by attachment of taping to change the peripheral circulation through autonomic nerves, and it is also considered possible that attachment of taping had an effect on the systemic circulation and caused a corresponding increase in the peripheral circulation at the site without Kinesio Tape. However, whether or not mild continuous local pressure with taping attached may have an influence on the local peripheral circulation should be examined further.

2. Effects of Kinesio Tape with exercise

The APG index showed no significant difference at the right toe (without Kinesio Tape attached) but showed significantly high values at the left toe with Kinesio Tape attached and the fingertip. The APG at the right and left toes, however, showed no significant difference.

These results indicate that low-strength exercise during attachment of Kinesio Taping to the lower thigh could improve the peripheral circulation at the left toe (with Taping attached). It is believed that the rhythmical exercise in the lower limbs by a low strength bicycling exercise produced lateral flexion of the bottom of the ankle joint with a taping onto the gastrocnemial muscle and rhythmical pressure and relaxation of the gastrocnemial muscle to accelerate the venous perfusion.

It can be said that this may show the possibility that a program for improvement of the peripheral circulation may be easier for obese people, the elderly and the people with diseases requiring much time to improve the peripheral circulation by exercises, by combining “attachment of Kinesio Tape + low-strength exercise” .