Comparison of the Immediate Effects of Functional Massage and Stretching Methods on the SRT, Knee Angles, and Leg Lengths of Adults with Insufficient Exercises

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Abstract

In the modern society, as the quality of life has been improving and social interest in health and well-being has been increasing, the importance of exercise has been emphasized so that many people actively participate in exercise and conduct many studies on physical activities and exercise. Therefore, in the present study, the lower extremities that are closely related to walking out of the body and can be easily damaged during daily living or sports activities were selected to conduct experiments to apply functional massage and stretching to the lower extremities of adults with insufficient lower extremity exercise in order to compare immediate effects with a view to making activities good before starting daily living or outdoor activities, or sports activities. The subjects were divided into a functional massage group(n: 30) and a stretching group(n: 30) and the participants participated in the experiment through voluntary applications after firsthand hearing explanations about the experiment from the therapist. In order to examine differences in the effects of the intervention between the Functional massage and stretching groups, the independent samples t-test and paired t-tests were performed. An experiment was conducted with functional massage and the results showed statistically significant differences in all comparison items. This may mean that the improvement of overall lower extremity functions and the intervention method stretching could be also regarded to be a very effective method for improvement of lower extremity functions.

Keywords: Functional massage, Stretching, Quality of Life

1. Introduction

In the modern society, as the quality of life has been improving and social interest in health and well-being has been increasing, the importance of exercise has been emphasized so that many people actively participate in exercise and conduct many studies on physical activities and exercise[1]. Exercise is a type of physical activities that plans moving activities or selects improved activities. Examples of exercise include walking, quick steps, running, cycling, aerobics, swimming, hiking, and muscle strength exercise. In addition, exercise generally requires active activities which sometimes lead to physiological changes or physical damage[2]. As modern people’s interest in health and qualitative improvement of life has been increasing, populations participating in exercise and sports have been continuously increasing. Despite these positive aspects of physical activities, musculoskeletal system injuries related to sports and leisure activities occur frequently and the
annual incidence has been reported to have been continuously increasing[3]. Among injuries to musculoskeletal system soft tissues, those to the quadriceps femoris muscle and the hamstring that play important roles in walking have been particularly more frequent. Among those injuries, muscle tears, ligament strains, and tendon contusions are representative[4]. When the quadriceps femoris muscle and the hamstring have been damaged, the flexion and extension of the knee joint will be limited and joint flexibility will be deteriorated over time leading to joint spasticity[5]. Currently, many kinds of muscle strengthening exercises and diverse other forms of exercises are performed to prevent problems in the quadriceps femoris muscle or the hamstring in advance. The most representative muscle strengthening exercises should be squat exercises[6]. In addition, exercises may be performed using unstable bearing surfaces to stabilize the entire lower extremities or using gym balls or aero steps to improve lower extremity balance and muscle strength[7]. As a method of preventing or reducing exercise injuries that may occur due to increases in exercise or outdoor activities, stretching before exercise can be said to be important and those types of stretching that are used to increase muscle expansibility are mild contraction exercises that increase internal pressure of muscles. Rhythmic contractions or mild compression of muscles accelerates blood flows in veins to smoothen blood circulation, improves blood flows, and plays the role of removing fatigue substances[8]. The stretching as such can be easily performed by anybody because such types of stretching do not require any high level physical skill or special equipment and can be performed with a light heart without being restricted by time or place[9]. Stretching is usually divided into static stretching and elastic stretching. Static stretching is a form of exercise that is maintaining sufficiently stretched states and has advantages such as reducing reflexive contractions of muscles, consuming less energy, and involving low possibilities of tissue injuries or muscle pain. On the contrary, elastic stretching is a conventional method that uses rebounding motions or laterally and vertically shaking motions and is known to be a preparation process for muscle activities intended to strengthen muscles’ performance capabilities and prevent injuries[10].

Functional massage and manual therapy are also among general, effective, and popular treatment methods used for muscles and soft tissues after active and intense exercise and for recovery from muscle weakening. In addition, lower extremity strengthening exercises can be performed using slings or small tools[11][12]. Among others, massage is widely used not only in sports fields but also among general people because it is used with bare hands to improve motor abilities in many movements of human bodies, is relatively easy to learn, and can be effective even when applied for a short time[13]. In general, massage is known to be capable of relieving muscle strain by applying mechanical pressure to soft tissues, improving the range of joint motions and nervous excitement, and increasing the circulations of blood and the lymph fluid by mechanically increasing the pressure in the blood vessels in muscles[14]. Therefore, in the present study, the lower extremities that are closely related to walking out of the body and can be easily damaged during daily living or sports activities were selected to conduct experiments to apply functional massage and stretching to the lower extremities of adults with insufficient lower extremity exercise in order to compare immediate effects with a view to making activities good before starting daily living or outdoor activities, or sports activities.
2. Methods

2.1. Study Design

The subjects were divided into a functional massage group (n: 30) and a stretching group (n: 30) and the participants participated in the experiment through voluntary applications after firsthand hearing explanations about the experiment from the therapist. The stretching group was applied with a standardized lower extremity stretching program during the experiment and the functional massage group was applied with massage by the therapist during the experiment. Immediate effects were examined after participation in the study one time by measuring the knee angle and the leg length of the leg applied with the intervention methods and by conducting Sit and Reach Tests.

2.2. Study Subjects

In the present study, male and female university students without any physical deformity majoring in physical therapy were selected and assigned to a functional massage group of 30 subjects and a stretching group of 30 subjects using the Excel random extraction method. According to the subject selection criteria, those that had any neurological or orthopedic problem in their spine or those that had lower back pain within the immediately previous three months were excluded from the study subjects. In addition, those that were performing strenuous exercise at normal times and those that were walking or exercising regularly were not selected as the subjects. The participants were provided a written informed consent form in accordance with the ethical standards of the Declaration of Helsinki. The subjects were analyzed using the independent t-test; the results are presented in Table 1.

Table 1. General Characteristics of the Subjects (Mean±SD)

<table>
<thead>
<tr>
<th></th>
<th>Functional massage (n=30)</th>
<th>Stretching (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>23.27 ± 1.46</td>
<td>20.27 ± 0.14</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>61.40 ± 9.99</td>
<td>62.67 ± 8.72</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>170.49 ± 7.18</td>
<td>167.60 ± 5.85</td>
</tr>
</tbody>
</table>

2.3. Experimental Procedure and Measuring Method

The knee angles, leg lengths, SRTs, and strides of all subjects in the stretching group and functional massage group were measured before and after applying the respective intervention methods. The knee angles were measured by measuring the flexibility of the hamstring which is a popularized method utilizing 90/90 hamstring stretches. Each subject bent the hip joint and the knee joint of the leg being measured in a supine position on the floor and extended the knee thereafter. At that time, the amount of change in the knee angle was measured. The leg length was measured by measuring the distance from the ASIS to the Medial Malleolus. The SRT was measured using Sitting Trunk Flexion Meters (TAKEI, Japan). The subject sat with the two feet 5 cm apart placed in contact with the footplate, put the hands together, bent the trunk forward without bending the knee, and maintained the bent posture for 5 sec. to measure the SRT. The SRT was measured three times and the average value was recorded. All measurements were conducted in the same period and in the same environment of the measuring room and the subjects did not wear...
any shoes during the measurements and were controlled not to do any strenuous exercise or weight training before the measurements.

2.4. Intervention Program

The intervention method of the stretching group was divided into three steps. In the first step, the subject bent the hip joint by 90° and placed the foot on the table. Thereafter, while the foot was in a state of Dorsi Flexion, the leg was stretched and the posture was maintained for 20 sec. Thereafter, the leg was returned to the original position to take a rest for 10 sec. This stretching was repeated in the same method. In the second step, the subject bent the knee joint of one leg and extended the knee joint of the other leg and stretched the leg with the extended knee joint by pulling the end of the foot toward the trunk using the two hands for 30 sec. Thereafter, the subject took a rest for 15 sec. This stretching was repeated in the same method. In the third step, the subject bent the knee joint of one leg and pulled the other leg toward the breast while bending the knee joint. Thereafter, the knee joint of the pulled leg was extended while the foot was in a state of dorsi flexion to stretch the leg for 30 sec. Thereafter, the subject took a rest for 15 sec. This stretching was repeated in the same method.

The subjects in the functional massage group were given functional massage for 30 minutes. Physical therapists with a clinical career for 10 years gave massage on the quadriceps femoris muscle and the biceps femoris muscle as follows.

(Quadriceps femoris) After having the patient lie on the bed in a supine position, the therapist moved the patient to the edge of the bed so that the knee joint could be moved and made a starting posture by placing his fixed hand on the femoral region of the patient, holding the patient’s ankle with the moving hand, and extending the knee joint. In the shortened posture, the therapist applied soft pressure with the fixed hand toward the origin of the quadriceps femoris muscle and bent the knee joint with the moving hand to move the leg in the extending direction. The therapist repeated the foregoing within the range in which the patient did not feel pain. While the functional massage was given, the patient bent the knee joint a little according to the movements of the therapist’s moving hand.

(Biceps femoris) After having the patient lie on the bed in a prone position, the therapist moved the patient to be comfortable so that the knee joint could be moved and made a starting posture by placing his fixed hand on the biceps femoris muscle region of the patient, holding the patient’s ankle with the moving hand, and bending the knee joint. In the shortened posture, the therapist applied soft pressure with the fixed hand toward the origin of the biceps femoris muscle and extended the knee joint with the moving hand to move the leg in the extending direction. The therapist repeated the foregoing within the range in which the patient did not feel pain. While the functional massage was given, the patient extended the knee joint a little according to the movements of the therapist’s moving hand. The intervention time of the two groups was the same, 30 minutes.

2.5. Statistical Analysis

SPSS for Windows (Version 20.0) was used to statistically analyze the data. Differences in the general characteristics of the subjects were analyzed by performing the independent samples t-test. In order to examine differences in the effects of the intervention between the Functional massage and stretching groups, the independent samples t-test and paired t-tests were performed. The statistical significance level was chosen as 0.05.
3. Results

As for changes in the knee angle, in the Stretching group, the mean left and right knee angles were 26.40±10.31 and 26.93±9.51 respectively before intervention and 26.33±10.10 and 28.07±8.90 respectively after intervention and the difference in the right knee angle between before and after intervention was statistically significant. As for changes in the leg length, in the Stretching group, the mean left and right leg lengths were 86.83±2.87 and 86.90±2.89 respectively before intervention and 85.66±3.03 and 86.26±3.39 respectively after intervention the differences in the leg lengths between before and after intervention were not statistically significant in both legs. As for changes in the SRT, the Stretching group showed statistically significant difference between before and after intervention with a change in the value from 9.37±4.51 before intervention to 12.58±5.69 after intervention(Table 2)(Figure 1).

Table 2. Comparison of Knee Angle, Leg Length, and SRT in the Stretching Group

<table>
<thead>
<tr>
<th></th>
<th>Pre-test (n=30)</th>
<th>Post-test (n=30)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>KA(left)(°)</td>
<td>26.40 ± 10.31</td>
<td>26.33 ± 10.10</td>
<td>0.38</td>
<td>0.702</td>
</tr>
<tr>
<td>KA(right)(°)</td>
<td>26.93 ± 9.51</td>
<td>28.07 ± 8.90</td>
<td>-3.42</td>
<td>0.002*</td>
</tr>
<tr>
<td>LL(left)(cm)</td>
<td>86.83 ± 2.87</td>
<td>85.66 ± 3.03</td>
<td>1.56</td>
<td>0.128</td>
</tr>
<tr>
<td>LL(right)(cm)</td>
<td>86.90 ± 2.89</td>
<td>86.26 ± 3.39</td>
<td>0.82</td>
<td>0.416</td>
</tr>
<tr>
<td>SRT(cm)</td>
<td>9.37 ± 4.51</td>
<td>12.58 ± 5.69</td>
<td>-2.56</td>
<td>0.016*</td>
</tr>
</tbody>
</table>

*p<0.05, KA; knee angle, LL; leg length, SRT; Sit and Reach Test (Mean±SD)

Figure 1. Result of Knee Angle, Leg Length, and SRT in the Stretching Group

*p<0.05, KA; Knee Angle, LL; leg length, SRT; Sit and Reach Test
As for changes in the knee angle, in the Functional massage group, the mean left and right knee angles were 32.47 ± 8.81 and 30.73 ± 9.04 respectively before intervention and 33.60 ± 9.23 and 33.80 ± 7.77 respectively after intervention and the difference in the right knee angle between before and after intervention was statistically significant. As for changes in the leg length, in the Functional massage group, the mean left and right leg lengths were 89.20 ± 4.44 and 86.93 ± 4.42 respectively before intervention and 89.46 ± 4.27 and 88.93 ± 4.59 respectively after intervention the differences in the leg lengths between before and after intervention were statistically significant in both legs. As for changes in the SRT, the Functional massage group showed statistically significant difference between before and after intervention with a change in the value from 8.09 ± 6.56 before intervention to 15.95 ± 6.70 after intervention (Table 3)(Figure 2).

**Table 3. Comparison of Knee Angle, Leg Length, and SRT in the Functional Massage Group**

<table>
<thead>
<tr>
<th></th>
<th>Pre-test (n=30)</th>
<th>Post-test (n=30)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>KA(left)(°)</td>
<td>32.47 ± 8.81</td>
<td>33.60 ± 9.23</td>
<td>-3.84</td>
<td>0.001*</td>
</tr>
<tr>
<td>KA(right)(°)</td>
<td>30.73 ± 9.04</td>
<td>33.80 ± 7.77</td>
<td>-6.49</td>
<td>0.000*</td>
</tr>
<tr>
<td>LL(left)(cm)</td>
<td>89.20 ± 4.44</td>
<td>89.46 ± 4.27</td>
<td>-2.64</td>
<td>0.013*</td>
</tr>
<tr>
<td>LL(right)(cm)</td>
<td>86.93 ± 4.42</td>
<td>88.93 ± 4.59</td>
<td>-9.57</td>
<td>0.000*</td>
</tr>
<tr>
<td>SRT(cm)</td>
<td>8.09 ± 6.56</td>
<td>15.95 ± 6.70</td>
<td>-5.10</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

*p<0.05, KA; knee angle, LL; leg length, SRT; Sit and Reach Test (Mean±SD)

**Figure 2. Result of Knee Angle, Leg Length, and SRT in the Functional Massage Group**

*p<0.05, KA; knee angle, LL; Leg Length, SRT; Sit and Reach Test
Comparison of the two groups showed a statistically significant difference. The following results were as shown in the following table and figure. The angle of the knee, leg length, SRT. It showed a statistically significant difference(Table 4)(Figure 3).

Table 4. Comparison of the Functional Massage and Stretching between Groups

<table>
<thead>
<tr>
<th></th>
<th>Functional massage (n=30)</th>
<th>stretching (n=30)</th>
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<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>KA(left)(°)</td>
<td>33.60 ± 9.23</td>
<td>26.33 ± 10.10</td>
<td>-2.90</td>
<td>0.005*</td>
</tr>
<tr>
<td>KA(right)(°)</td>
<td>33.80 ± 7.77</td>
<td>28.07 ± 8.90</td>
<td>-2.65</td>
<td>0.010*</td>
</tr>
<tr>
<td>LL(left)(cm)</td>
<td>89.46 ± 4.27</td>
<td>85.66 ± 3.03</td>
<td>-3.97</td>
<td>0.000*</td>
</tr>
<tr>
<td>LL(right)(cm)</td>
<td>88.93 ± 4.59</td>
<td>86.26 ± 3.39</td>
<td>-2.55</td>
<td>0.013*</td>
</tr>
<tr>
<td>SRT(cm)</td>
<td>15.95 ± 6.70</td>
<td>12.58 ± 5.69</td>
<td>-2.09</td>
<td>0.040*</td>
</tr>
</tbody>
</table>

*p<0.05, KA; knee angle, LL; leg length, SRT; Sit and Reach Test (Mean ± SD)

Figure 3. Result of Knee Angle, Leg Length, and SRT in the Functional Massage and Stretching between Groups

*p<0.05, KA; Knee Angle, LL; Leg Length, SRT; Sit and Reach Test

4. Discussion

The present study was conducted to divide normal adults that do not perform lower extremity exercises regularly at normal times into a functional massage group and a stretching group and apply respective intervention methods in order to examine what benefits the interventions provide for changes in the functions of the lower extremities. In the present study, changes in functions can be said to be changes in knee angles, leg lengths, the SRT of the trunk and the flexibility of the
legs. In modern society, the quality of life has been improved leading to increases in leisure activities and individuals’ sports activities, which resulted in increases in the probability of muscle injuries, in particular, lower extremity muscle injuries[15]. In addition, damage to the musculoskeletal system can frequently occur even during daily living. Muscle injuries will limit physical activities and if limited activities are continuously performed, joint contracture, shortening, or problems in functional activities of joints may occur. Therefore the prevention of muscle injuries should be important[16]. If knee joint angles gradually decrease, the knee joint will be affected during the stance phases and swing phases of walking leading to adverse effects on walking activities. Since the role of the lower extremities is the most important in walking and movements, the body should be managed through accurate evaluation and management of lower extremity functions before problems occur[17]. Therefore, in the present study, although there are various lower extremity function measuring methods, SRT, 90/90 hamstring stretch, and leg length that are evaluation indexes frequently used at clinics and are mainly used for judgment because of smaller variations than indexes used by other measuring methods were used to evaluate lower extremity functions[18][19][20]. In the present study, study results showed statistically significant differences in knee angles, leg lengths, and SRT between before and after intervention within the functional massage group and the stretching group. This is thought to mean that individual intervention methods are helpful for improvement of knee angles, leg lengths, and SRT functions and can have positive effects on adults that suffered sports damage or injuries in their lower extremity musculoskeletal system during daily living. However, in the stretching group, differences in left knee angles and leg lengths between before and after intervention were not statistically significant. In comparison between the groups, SRT was shown to be statistically different between the functional massage group and the stretching group. In addition, knee angles and leg lengths were also shown to be statistically different. This may indicate that the functional massage group showed more effective functional improvement than the stretching group. Currently, there are not so many direct studies that compare functional massage and stretching to examine functional improvement but a few studies are in progress in which functional massage is combined with manual therapy[21]. There was a study in which after a massage technique was applied one-off to the ankles and soles of elderly persons similarly to the present study and joint mobilization was applied together with static pressure and sliding pressure, significant increases in the time of one leg balance and the distance of lateral reach were observed[22]. Thereafter, there was a study in which it was reported that after applying skin pressure to the feet and ankles of elderly persons with deteriorated proprioceptive senses, the ankle position sense was improved[23]. In a study conducted with healthy adults, when muscles adjacent to the knee joint were stretched with manual therapy and 45° knee flexion postures were reproduced, significant improvement in the accuracy of reproduction was observed[24]. As with the results of previous studies as such, in the present study too, the massage technique and stretching applied to the quadriceps femoris muscle of the thigh and the biceps femoris muscle are thought to have affected the changes in knee joint angles, and leg lengths and the improvement of SRT[25]. Although the mechanism through which functional massage improves proprioceptive senses has not been clearly known, the simulation of the mechanical receptors distributed on the skin, muscles, and tendons by massage can be considered to adjust such reactions. Bio-mechanically, massage is thought to apply mechanical pressure to soft tissues and have extending effects. When the results of the present study are put together, it could be seen that although both functional massage and stretching were
effective for improvement of normal adults’ lower extremity functions, the group applied with functional massage showed generally better results than the group applied with stretching. Since the flexibility of the knee joints of the lower extremities and the connecting region of the trunk plays important roles in modern people’s sports activities and daily living activities in particular, shortening of or damage to such regions can become a cause of deterioration of other related functions. The intervention with functional massage is necessary for stroke patients to solve such problems and it could be seen that the functional massage attempted in the present study is an intervention method helpful for the improvement of lower extremity functions and ability. The clinical relevance of the results of the present study should be evaluated in another study. Limitations of the present study include the fact that the number of participants was not large, the fact that the intervention method cannot be easily generalized for application, and the fact that since single measuring methods were used in the experiment, long-term and effective treatment effects could not be examined.

5. Conclusions

In the present study, to examine the effects of functional massage and stretching as intervention methods on the SRT, knee angles, and leg lengths of adults with insufficient lower extremity exercise, 60 normal adults were randomly assigned to a functional massage group and a stretching group. An experiment was conducted with functional massage and the results showed statistically significant differences in all comparison items. This may mean that the improvement of overall lower extremity functions and the intervention method stretching could be also regarded to be a very effective method for improvement of lower extremity functions. However, the group applied with functional massage showed larger effects and in particular, functional massage is thought to be a very useful method for improvement of flexibility and increases in the mobility of knee joints. The improvement of functions is thought to be helpful for daily living and sports activities or the movements of the lower extremities during exercise. In addition, functional massage is thought to be a very efficient intervention method for subjects that suffered damage to their lower extremities and continuous studies on the effects are thought to be necessary for increases in clinical utilization.

References


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