An Acute Effects of Applied Stretching in Soccer Game Break Time

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Abstract

Background/Objectives: The purpose of this study was to investigate the effect of the static and dynamic stretching on agility and balance during break time of soccer game. Methods/Statistical Analysis: This study was performed for 25 among healthy university soccer team students. All data were analyzed using the statistical software SPSS ver. 23.0. The data were expressed as the mean ± standard deviation of the mean (SDM). For the comparison among the groups, two-way ANOVA and paired t-test was performed for the difference within a group. Significance was set as α < .05. Findings: The agility results within a group depending on whether stretching was applied or not were - .41sec (p > .05) in the group to which the static type of stretching was applied and it was - .442sec (p < .05) in the group to which the dynamic type of stretching was applied. Therefore, both the two groups showed a result of the shortened time. There was a meaningful difference in the group to which the dynamic type of stretching was applied (p < .05) in comparison to the group to which the static type of stretching was applied (p > .05).

Keywords: Agility, Balance, Break Time, Soccer, Stretching, Y-balance Test

1. Introduction

Elite soccer teams spare a considerable amount of time in the stretching for training and game preparation¹. This is due to the perception that stretching is a good method of warming-up to prevent injuries by relaxing muscular tension through extending the length². Especially, the study by:³ argues that the soccer teams in the British Premier league spent 40% of training time on the flexibility training using a static type of stretching.

Many scholars still argue that both the static and dynamic types of stretching cause a certain level of the increased joint working range and have an effect on the injury prevention⁴,⁵. However, others argue that it is not fair to equate the effect of the PNF with other kinds of stretching because the power and load that is applied by an assistant in most studies was not controlled in the PNF, and the PNF stretching generally requires much more power than the static or dynamic types of stretching⁶.

Like these, many people are doing a lot of stretching for injury prevention and flexibility whereas there are many skeptical opinions being reported before people can actually see the effect. Particularly, when there have been many recent studies denying the effect of stretching, it is necessary to perform a research in association with the most popular kinds of stretching at this point of time.

In the analysis of stretching, a multilateral study is needed on the link between the internal muscular contraction conditions (muscle bundle length, array angle, thickness, neuromuscular facilitation) and the external environmental stimulation (stretching types), and the associated phenomenon. This relationship, which is the magnitude of force produced (torque), can be analyzed by observing the shift aspect, contraction reaction, and ROM change of the Torque-Angle Relationship curve.

In order for the joint working range to increase in relation to the stretching, or for the athletic performance ability to improve, the mechanical characteristics...
of muscle, that is, the structural change should be accompanied.

Generally, the structural characteristics of muscle can be defined using the muscle bundle length, array angle, and its thickness and therefore, it is important to understand and compare the aspects such as muscle bundle length, array angle, and muscular thickness in order to evaluate and analyze the functions of skeletal muscle.

Another part which cannot be overlooked from the structural point of view is the characteristics of the muscle-tendon complex. The tendon tissue is anatomically divided into the osteo-tendinous junction and the myo-tendinous junction and it is known that the whole length of the muscle-tendon complex does not change in isometric contraction but the muscular fibers of human vastus medialis and inner gastrocnemius get shortened by 30%.

reported that the maximum extension of aponeurosis is roughly eight percent whereas said that it is about nine to ten percent. Since the tendon tissue is the inactive tissue that is elastic and connected with the muscle in series and it engages in saving and using the elastic energy through the interaction with muscle the structural-morphological and material mechanics characteristics of the tendon tissue and its interaction with muscle have to be considered for analysis.

Agility is defined as the ability to make an effective change of direction while moving a body as fast as possible. In particular, when looking in a sports site, while soccer and basketball uses agility for the fast offense and defense switch, volleyball and foot volleyball uses agility to move fast from left to right hand sides or the other way according to the dropping location of a ball not to lose a score. Likewise, there is the planned agility that adjusts a movement by knowing in which direction to go and also the responsive agility which cannot be planned.

These kinds of agility can be said to have much to do with the nervous system. The speed of neurotransmission is about 70–120m/sec and it takes as fast as 120m/sec to travel the whole body including the centrifugal nerve. In other word, agility is decided by the fast muscular contraction depending on how well balanced the function and muscle is in the nervous system.

Even though it is expected that there might have been many studies on the agility according to the types of stretching, a majority number of studies have been carried out mainly regarding the muscular strength and power of the isokinetic knee joint and the quickness in the standing high jump and long jump. When looking at the journals which studied agility, they primarily focused on the agility to direction of back and forth. It is necessary to examine agility to other directions than only back and forth.

In soccer game, balance play a great role in many factors, including muscle strength neuromuscular function.

Therefore, this study aims to provide directors and trainers in a sports training site with scientific information by examining agility to the direction of left and right hand sides as well as back and forth through the static and dynamic types of stretching and looking at more effective types of stretching through comparison of different types.

2. Methods

2.1 Participants

This study was performed for 25 males (age: 21.88 ± 2.00 years old, height: 175.56 ± 5.09 cm, weight: 71.72 ± 8.34 kg) among healthy university soccer team students without an orthopedic medical history who voluntarily wanted to participate after having listened to enough explanation of the study content and purpose, test procedures, protection of human rights of participants, and the safety of study. The general characteristics of the participants are as in Table 1.

| Source       | Group A (n=12) | Group B (n=13) |
|--------------|---------------|---------------|
| age          | 22.00±1.82    | 21.69±2.17    |
| height(cm)   | 176.07±5.20   | 174.53±5.19   |
| weight(kg)   | 73.66±6.74    | 69.92±9.50    |

2.2 Test Methods

2.2.1 Experimental Set-up

Two groups were randomly made out of the 25 male university soccer team players and each of the static and dynamic stretching was applied by quoting the stretching protocol of. The evaluation for the baseline measurement was carried out once after the warming-up prior to the game and then, once after the 45 minute training (first half of
game). After five days, the stretching protocol was applied to each group once after the warming-up prior to the game, and also once after the 45 minute training. After processing a single session of evaluation, measurement was repeated four times in total. The experimental set-up is like in Table 2.

Table 2. Experimental set-up

| Pre-test (n=25) | Post-test (n=25) |
|----------------|----------------|
| **Group A**   | **Group B**   |
| warm-up       | warm-up       |
| ↓             | ↓             |
| Assessment(1) | Assessment(1) |
| ↓             | ↓             |
| Training for 45min | Training for 45min |
| ↓             | ↓             |
| Assessment(2) | Assessment(2) |
| **Static Stretching** | **Dynamic Stretching** |
| Group A        | Group B        |
| warm-up        | warm-up        |
| ↓             | ↓             |
| Assessment(3) | Assessment(3) |
| ↓             | ↓             |
| Training for 45min | Training for 45min |
| ↓             | ↓             |
| Static Stretching | Dynamic Stretching |
| ↓             | ↓             |
| Assessment(4) | Assessment(4) |

2.2.2 Stretching Protocol

Each of the stretching movements quoted from the study protocol of 17 was made to be kept for 30 seconds, and the strength of stretching was set to the medium not to be uncomfortable for each individual and it was performed by both groups. The composition of each stretching is like in Table 3.

Table 3. Stretching protocol

| Stretching type | Protocol                                      |
|-----------------|-----------------------------------------------|
| Static stretching | front deltoïd and pectoral stretch            |
|                 | side deltoïd stretch                          |
|                 | triceps and side-bend stretch                 |
|                 | adductor stretch                              |
|                 | modified hurdlers stretch                     |
|                 | quadriceps wall stretch                       |
|                 | calf stretch                                  |
| Dynamic stretching | side/front arm crossover                    |
|                 | walking lunge with rotation                   |
|                 | triceps and side-bend stretch                 |
|                 | lateral shuffle                               |
|                 | frankenstein walks                            |
|                 | heel-ups                                     |
|                 | inch worms(hand walk)                         |
|                 | modified shuttle run                          |

2.2.3 Measurement Methods

This study carried out tests with five days apart to find out the acute effect of each type of stretching applied during the game break time on agility and balance ability.

2.2.3.1 Agility

The Illinois agility test of 18 was performed which modified and applied the Illinois agility test used in the study of 17. A rectangular course which is 10m in length and 5m in width was made using four cones, and in the center of the rectangular course, four cones are put every 3.3m. The participants started from a standing position and performed turns along the designated course. Examiners measured time using a stopwatch.

2.2.3.2 Balance Ability Test

Y-balance test is a measurement method invented to enhance the repetition of the star excursion balance test which is commonly used to measure the muscular force, flexibility and proprioceptive sense of the lower limbs. It recorded the distance from the center to the point where the leg was stretched in three different directions of anterior, posteromedial, and posterolateral for each lower limb in a unit of cm, and used an average value from the three repeated measurements of each direction. When the supporting foot fell on the ground or a leg did not return to the starting position after having been stretched, or if the stretched leg to make a balance was used to support on the floor, it was all regarded as a failure19.

2.3 Data Analysis

The data of the measured results of this study was processed using the statistical program SPSS 23.0. An average and standard deviation was calculated for the result of each variable. For the statistical verification methods, the paired t-test was performed for the difference within a group according to the type of stretching, and the two-
Table 6. Y-balance paired t-test

| Source | Group   | M       | SD      | SEM     | t       | df  | p     |
|--------|---------|---------|---------|---------|---------|-----|-------|
|        |         |         |         |         |         |     |       |
| Rt. ant.| static  | 1.084   | ± 6.455 | ± 1.863 | .582    | 11  | .572  |
|        | dynamic | 3.743   | ± 4.142 | ± 1.148 | 3.259   | 12  | .007* |
|        |         |         |         |         |         |     |       |
| Rt. PM | static  | 3.057   | ± 12.862| ± 3.713 | .823    | 11  | .428  |
|        | dynamic | 2.540   | ± 7.466 | ± 2.070 | 1.127   | 12  | .243  |
|        |         |         |         |         |         |     |       |
| Rt. PL | static  | 2.303   | ± 9.397 | ± 2.712 | .849    | 11  | .414  |
|        | dynamic | 3.204   | ± 7.630 | ± 2.116 | 1.514   | 12  | .156  |
|        |         |         |         |         |         |     |       |
| Lt. ant.| static  | 1.333   | ± 5.302 | ± 1.530 | .871    | 11  | .402  |
|        | dynamic | 3.741   | ± 5.336 | ± 1.535 | 2.347   | 12  | .031* |
|        |         |         |         |         |         |     |       |
| Lt. PM | static  | 2.668   | ± 7.701 | ± 2.223 | 1.200   | 11  | .255  |
|        | dynamic | 4.181   | ± 7.380 | ± 2.046 | 2.043   | 12  | .064  |
|        |         |         |         |         |         |     |       |
| Lt. PL | static  | 4.136   | ± 8.066 | ± 2.328 | 1.776   | 11  | .103  |
|        | dynamic | 3.203   | ± 7.702 | ± 2.136 | 1.500   | 12  | .160  |

Rt. Ant: Right Leg Anterior, Rt PM: Right Leg Posteromedial, Rt. PL: Right Leg Posterolateral, Lt. ant: Left Leg Anterior, Lt. PM: Left Leg Posteromedial, Lt. PL: Left Leg Posterolateral. *p<0.05.

Table 7. Y-balance two way repeated ANOVA

| Source | Type 3 SS | df | MS | F   | p   |
|--------|-----------|----|----|-----|-----|
|        |           |    |    |     |     |
| Rt. ant.| Time     | 72.726 | 1.000 | 72.726 | 5.036 | .035* |
|        | Time-Group| 22.071 | 1.000 | 22.071 | 1.528 | .229  |
|        | Group    | 8.019 | 1.000 | 8.019 | .527 | .475  |
|        |           |    |    |     |     |
| Rt. PM | Time     | 97.756 | 1.000 | 97.756 | 1.807 | .192  |
|        | Time-Group| .836 | 1.000 | .836 | .015 | .902  |
|        | Group    | 62.650 | 1.000 | 62.650 | 1.329 | .261  |
|        |           |    |    |     |     |
| Rt. PL | Time     | 94.653 | 1.000 | 94.653 | 2.607 | .120  |
|        | Time-Group| 2.534 | 1.000 | 2.534 | .070 | .794  |
|        | Group    | 72.358 | 1.000 | 72.358 | 2.470 | .130  |
|        |           |    |    |     |     |
| Lt. ant.| Time     | 80.353 | 1.000 | 80.353 | 5.459 | .029* |
|        | Time-Group| 18.094 | 1.000 | 18.094 | 1.229 | .279  |
|        | Group    | 16.468 | 1.000 | 16.468 | 1.301 | .266  |
|        |           |    |    |     |     |
| Lt. PM | Time     | 146.393 | 1.000 | 146.393 | 5.156 | .033* |
|        | Time-Group| 7.144 | 1.000 | 7.144 | .252 | .621  |
|        | Group    | 14.131 | 1.000 | 14.131 | .296 | .591  |
|        |           |    |    |     |     |
| Lt. PL | Time     | 168.115 | 1.000 | 168.115 | 5.417 | .029* |
|        | Time-Group| 2.715 | 1.000 | 2.715 | .087 | .770  |
|        | Group    | .188 | 1.000 | .188 | .003 | .955  |

TIM: Time Interval for Measurement, SS: Static Stretching, Rt. Ant: Right Leg Anterior, Rt PM: Right Leg Posteromedial, Rt. PL: Right Leg Posterolateral, Lt. Ant: Left Leg Anterior, Lt. PM: Left Leg Posteromedial, Lt. PL: Left Leg Posterolateral. *p<0.05.
way repeated ANOVA was carried out for the difference between the groups. All the statistical significance level was set up as $\alpha = .05$. The statistical analysis was performed using a gap value between the two pre-tests {test (2)-test (1)}, and a gap value between the two main tests {test (4)-test (3)}.

### 3. Results

#### 3.1 Agility

The results of the effect of stretching applied during the game break time on agility are like in Table 4 and Table 5. The agility results within a group depending on whether stretching was applied or not were $-.41\text{sec}(p > .05)$ in the group to which the static type of stretching was applied and it was $-.442\text{sec}(p < .05)$ in the group to which the dynamic type of stretching was applied. Therefore, both the two groups showed a result of the shortened time. Even though the two groups showed a change after the application of stretching, there was no meaningful difference between the two groups according to the types of stretching.

**Table 4.** Agility paired t-test

| Source | Group   | M   | SD   | SEM  | t    | df | p    |
|--------|---------|-----|------|------|------|----|------|
| agility| Static  | -.414| ± .707| ± .204| -2.029| 11 | .067 |
|        | Dynamic | -.442| ± .417| ± .115| -3.818| 12 | .002*|

*p<0.05

**Table 5.** Agility two-way repeated ANOVA

| Source | Type 3 SS | df | MS   | F   | p   |
|--------|-----------|----|------|-----|-----|
| Agility| 2.289     | 1.000| 2.289 | 13.861| .001*|
| Time   | .002      | 1.000| .002  | .015 | .904|
| Time · Group | .552 | 1.000| .522  | 1.891 | .182|

SS: Static Stretching. *p<0.05

#### 3.2 Balance Ability

The results of the effect of stretching applied during the game break time on the balance ability are like in Tables 6 and 7. In the measurement results of the balance ability within a group depending whether stretching was applied or nor, as for the anterior part of a right leg (Right leg anterior: Rt. ant.), there was a meaningful difference between the two groups according to the dynamic type of stretching was applied ($p < .05$) in comparison to the group to which the static type of stretching was applied ($p > .05$). As for the inner (Right leg posteromedial: Rt. PM) and outer part (Right leg posterolateral: Rt. PL) of the back of a right leg, both groups showed no meaningful difference. Just like the right leg, for the anterior part of a left leg, the group to which the dynamic type of stretching was applied showed a meaningful difference ($p < .05$) compared to the group to which the static type of stretching was applied ($p > .05$). As for the inner (Left leg posteromedial: Lt. PM) and outer part (Left leg posterolateral: Lt. PL) of the back of a left leg, both groups showed no meaningful difference. There was no difference between the groups according to the types of stretching.

#### 4. Conclusions

1. Both the two groups showed a result of the shortened time. Even though the two groups showed a change after the application of stretching, there was no meaningful difference between the two groups according to the types of stretching.

2. In the measurement results of the balance ability within a group depending whether stretching was applied or nor, as for the anterior part of a right leg (Right leg anterior: Rt. ant.), there was a meaningful difference in the group to which the dynamic type of stretching was applied in comparison to the group to which the static type of stretching was applied.

3. The anterior part of a left leg, the group to which the dynamic type of stretching was applied showed a meaningful difference compared to the group to which the static type of stretching was applied.

4. The inner (Left leg posteromedial: Lt. PM) and outer part (Left leg posterolateral: Lt. PL) of the back of a left leg, both groups showed no meaningful difference. There was no difference between the groups according to the types of stretching.

#### 5. References

1. Nédélec M, McCall A, Carling C, Legall F, Berthoin S, Dupont G. Recovery in soccer. Sports Medicine. 2012 Dec; 42(12):997–1015.

2. Witvrouw E, Mahieu N, Danneels L, McNair P. Stretching and injury prevention; an obscure relationship. Sports Medicine. 2004; 34(7):443–9.

3. Dadebo B, White J, George KP. A survey of flexibility training protocols and hamstring strains in professional football...
clubs in England. British Journal of Sports Medicine. 2004 Aug; 38(4):388–94.
4. Gajdosik R. Effects of static stretching on the maximal length and resistance to passive stretch of short hamstring muscle. Journal of Orthopaedic and Sports Physical Therapy. 1991; 14(6):250–5.
5. William D, Jean M, Michelle B. Effect of static stretch and dynamic range of motion training on the flexibility of the hamstring muscle. Journal of Orthopaedic and Sports Physical Therapy. 1998 Apr; 27(4):295–300.
6. Moore M, Hutton RS. Electromyographic investigation of muscle stretching techniques. Medicine & Science in Sports & Exercise. 1980; 12(5):322–9.
7. Fukunaga T, Roy RR, Shelloch FG, Hodgson, JA, Edgerton VR. Specific tension of human plantar flexors and dorsiflexors. Journal of Applied Physiology. 1996; 80(1):158–65.
8. Lieber RL, Friden J. Functional and clinical significance of skeletal muscle architecture. Muscle Nerve. 2000 Nov; 23(11):1647–66.
9. Jozsa L, Kannus P. Histopathological findings in spontaneous tendon ruptures. Scandinavian Journal of Medicine and Science in Sports. 1997 Apr; 7(2):113–18.
10. Ichinose Y, Kawakami Y, Ito M, Fukunaga T. Estimation of active force length characteristics of human vatus lateralis muscle. Acta Anatomica. 1997; 159(1):78–83.
11. Nardi MV, Binzoni T, Hilbrand E, Fasel J, Terrie F, Cerretelli P. In vivo human gastrocnemius architecture with changing joint angle at rest and during graded isometric contraction. Journal of Physiol. 1996; 496:287–97.
12. Lieber RJ. Frog semitendinous tendon load-strain and stress-strain properties during passive loading. American Journal of Physiology. 1991 Jul; 261(2):C86–92.
13. Ettema GIL, Huijing PA. Properties of tendinous structures and series elastic component of EDL muscle-tendon complex of the rat. Journal of Biomechanics. 1989; 22(1):1209–15.
14. Kawakami Y, Muraoka T, Ito S, Kanehisa H, Fukunaga T. In vivo muscle fiber behavior during counter-movement exercise in human reveals a significant role for tendon elasticity. Journal of Physiology. 2002; 540(4):635–46.
15. Enoka M. Neuromechanics of human movement. Human Kinetics 3rd Edn. Illinois; 2002. p. 112–68.
16. Tae-Gyu K, Jong-Chul P. Relationship between balance and isokinetic strength of ankle joint by playing position of elite female field hockey player. Indian Journal of Science and Technology. 2015 Aug; 8(19):1–6. DOI: 10.17485/ijst/2015/v8i19/75991.
17. Chatzopoulos D, Galazoulas C, Patikas D, Kotzamanidis C. Acute effects of static and dynamic stretching on balance, agility, reaction time and movement time. Journal of Sports Science and Medicine. 2014 May; 13(2):403–9.
18. Amiri-Khorasani M, Sahebozamani M, Tabrizi KG, Yusof AB. Acute effect of different stretching methods on Illinois agility test in soccer players. Journal of Strength and Conditioning Research. 2010; 24(10):2698–704.
19. Phillip JP, Paul PG, Robert JB, Kyle BK, Frank BU, Bryant E. The reliability of an instrumented device for measuring components of the star excursion balance test. Journal of Physiotherpy. 2009; 4(1):92–9.