Comparison between static and dynamic stretching in changes of limb muscle strength and flexibility of volleyball players

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Abstract. Volleyball is a sport uses passing, serve, block and smash techniques that requires good strength and flexibility of limb muscles. The static and dynamic stretching are used as warming up forms. The study aims to determine static and dynamic stretching toward changes in limb muscles strength and flexibility among volleyball players. The study was used two types of group sample with pre-test and post-test group design. The study population was all volleyball players in volleyball student activity unit of Hasanuddin University. The samples were 20 volleyball players who met the inclusion criteria included new volleyball player in student activity unit, male and willing to be respondents in this study. The limb muscles strength was measured using leg dynamometer test and flexibility was measured using sit and reach test. The result showed significant differences between static and dynamic stretching toward changes in limb muscle strength, p= 0.00<0.05. The static stretching is proven to decrease muscle strength with difference between pre-test and post-test is -7.07, while dynamic stretching is proven to increase muscle strength with difference between pre-test and post-test was 2.89. There was significant difference between static and dynamic stretching for limb muscle flexibility, p=0.005<0.05. Meanwhile, static stretching is proven to increase the limb muscle flexibility with difference between pre-test and post-test was 5.40, while dynamic stretching proven to improve limb muscle flexibility with the difference between pre-test and post-test was 3.00. Therefore, static stretching was more influential in improve the limb muscle flexibility.

1. Introduction
Most sports individuals or athletes need to perform stretching during warming up prior to physical activity to prevent injuries and improve sport performance by improving flexibility [1]. Sport is physical activity performed with goal of maintaining health and strengthening the body muscle. Volleyball is a game plays in form of team work or team co-operation where each team area is bound by the net and pass the ball to the opponent territory using legitimate techniques, tactics and playing the ball. The volleyball techniques such as smash, block, serve and pass requires limb muscle strength and flexibility.

The stretching exercises have many benefits on the athletes performance such as flexibility improvement, decreased muscle stiffness, injury protection [2]. Stretching is warm up activities which purpose to increase muscle flexibility and decrease muscle stiffness such as static and dynamic stretching [3]. The static stretching is generally used by athletes and person who active in physical
activity since static stretching can increase the range of motion [4]. Meanwhile, dynamic stretching had proven to improve power output, jumping ability and reaction time but opposite with static stretching shows the reduction in these performance [5].

The muscle performance will have an impact on a game and help in good achievement. The static stretching before exercise will reduce the optimal performance of the muscles and increase hamstring muscle performance. The study aims to determine static and dynamic stretching toward changes in limb muscles strength and flexibility among volleyball players.

2. Methodology

The study was used quasi experimental method with two group sample with pre-test and post-test group design. The study population was all volleyball players in studies activity unit of Hasanuddin University with total of 35 volleyball players. The samples were 20 volleyball players who met the inclusion criteria such as new volleyball players, male and willing to be respondents.

The data was collected with using pre-test and post-test on two group for static and dynamic stretching. The limb muscles strength was measured using leg dynamometer test and flexibility was measured using sit and reach test. The muscle strength and flexibility in pre-test and post-test on the static and dynamic stretching group were processed using SPSS program. The paired T test to determine the effect of static and dynamic stretching toward muscle strength and flexibility in volleyball players.

3. Result and Discussion

3.1. Result

The muscle strength was measured by using leg dynamometer test from pre-test and post-test. The decrement was occurred in 10 samples in the static stretching group before the post-test. In Graph 1, three highest values of leg dynamometer measurement were 127.5 kg, 125 kg and 119.6 kg. Meanwhile, lowest three distribution in this group were 40 kg, 47 kg and 48 kg.
Graph 2. Distribution of leg dynamometer (cm) among dynamic stretching group.

Meanwhile, dynamic stretching group was observed increased in value from pre-test and post-test. The increment occurred in 10 samples especially dynamic stretching. There were three highest value of 88 kg, 81 kg and 69 kg. In additions, lowest three distribution were 40 kg, 47 kg and 48 kg in this group.

Graph 3. Distribution of sit and reach test values (cm) among static stretching group.

In Graph 3, pre-test values in 10 samples showed an increment in post-test after given static stretching. Meanwhile, Graph 4 showed value distribution of muscle flexibility for dynamic stretching group. In Graph 3 and 4 showed significant changes. The changes is observed as increment in the muscle flexibility through sit and reach test in stem diagram in pre-test and post-test.
Graph 4. Distribution of sit and reach test value (cm) among dynamic stretching group.

In static stretching, the pre-test had mean and standard deviation of 87.41 and 33.23 while post-test had mean of 80.34 with standard deviation of 30.11. The difference between pre-test and post-test comparison of muscle strength in the static strength was -7.07. Meanwhile, difference between pre-test and post-test of muscle strength in the static strength was 2.89. There was significant changes in muscle strength before and after intervention for static and dynamic stretching, p=0.007<0.05 and p=0.001<0.05. Besides, there was significant differences between static and dynamic stretching in muscle strength in pre-test and post-test.

Table 1. Comparison of muscle strength between static and dynamic strength group.

| Group            | Mean±SD     | Differences | P*   | P**   |
|------------------|-------------|-------------|------|-------|
| Static stretching|             |             |      | 0.001 |
| Pre-test         | 87.41±33.23 | -7.07       | 0.007|
| Post-test        | 80.34±30.11 |             |      |       |
| Dynamic stretching|            |             |      |       |
| Pre-test         | 59.64±15.74 | 2.89        | 0.001|
| Post-test        | 62.53±15.59 |             |      |       |

p*= paired t-test; p**=independent t-test

In additions, mean of pre-test was 8.50 with standard deviation of 5.35 for static stretching. Meanwhile, post-test have mean of 13.90 with standard deviation of 5.04 for static stretching. Furthermore, pre-test had mean of 10.90 with standard deviation of 4.28 in dynamic stretching, while mean and standard deviation in post-test were 13.90 and 3.90 in dynamic stretching. The difference between pre-test and post-test in muscle flexibility was 5.4 in static stretching. There was significant changes in muscle flexibility in static stretching group during pre-test and post-test, p=0.001<0.05. Besides, there was significant changes in muscle flexibility in the dynamic stretching during pre-test and post-test, p=0.001<0.05. In additions, there was significant differences between static and dynamic stretching in the muscle flexibility during pre-test and post-test.
Table 2. Comparison of muscle flexibility between static and dynamic strength group.

| Group                | Mean±SD  | Differences | P*   | P**  |
|----------------------|----------|-------------|------|------|
| Static stretching    |          |             |      |      |
| Pre-test             | 8.50±5.35| 5.4         | 0.001|      |
| Post-test            | 13.90±5.04|            |      |      |
| Dynamic stretching   |          |             |      |      |
| Pre-test             | 10.90±4.28|            |      |      |
| Post-test            | 13.90±3.90|            |      |      |

3.2. Discussion
The result found decreased in the muscle strength from pre-test to post-test was -7.07 in the static stretching. There was effect of static stretching toward muscle strength with p=0.007. The static stretching before exercise had low muscle strength compared to the dynamic stretching method. The decline in the strength due to changes in viscoelastic properties in the muscles which lead to decrease in musculotendinous stiffness.

In this study, 10 respondents in static stretching group had experienced decreased in muscle strength due to decreased in electrical activity in the muscle which affected the crossbridge mechanism in the muscle contraction process. In static stretching within 30 seconds had affected the reflex elasticity of the muscle due to the temporary elongation of muscles. The static stretching motion which has inactive motion and unrepeated until core temperature of the muscle is not significantly affected.

The static stretching had affected in neuromuscular activity and mechanical activity in form of viscoelasticity changes, as well as tendon and muscle strips resulted in decreased muscle strength. In dynamic stretching group, the difference between pre-test and post-test was 2.89 with p-value= 0.001. These results showed there was change in the increase of muscle strength.

Dynamic stretching caused post-activation potentiation that was temporary increased in muscle and increased muscle temperature [1]. Hence, the influence of decrement in muscle strength occurred in the static stretching group, while dynamic stretching was influenced by increment in leg muscle strength.

Meanwhile, the difference in muscle flexibility between pre-test and post-test for static stretching was 5.40. There was significant influence between static stretching and muscle flexibility. In additions, difference in muscle flexibility from pre-test and post-test in dynamic stretching was 3.00. There also significant influence between dynamic stretching and muscle flexibility.

The increment in flexibility achieved by stretching helped in prevent the muscle injury, tendons and joints and improve muscle performance capability. The static stretching is basic part of warming up for decades. Most people preferred this static stretching in improve hamstring muscle flexibility since this this technique only focused on certain muscles [2]. In dynamic stretching, whole body required to move and increased the body temperature, motor stimulation, kinesthetic sense and range of motion [3].Therefore, dynamic stretching technique can increase the hamstring muscle flexibility. However, dynamic stretching technique had lower scores than static stretching technique.

4. Conclusion
In conclusion, there was effect in static stretching on decrease in limb muscle strength among volleyball players. p= 0.007, while dynamic stretching was increased limb muscle strength in volleyball players. The static and dynamic stretching increased limb muscle flexibility among volleyball players. In additions, there was significant differences between static and dynamic stretching toward changes in muscles strength and flexibility among volleyball players.
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