

# THE EFFECTS OF MYOFASCIAL SELF-RELEASE METHOD AND TOOL APPLICATION ON ATHLETE STRENGTH INDICATORS IN TIBIA EXTENSOR MUSCLES IN FITNESS

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**Abstract.** *The aim of the present study was to analyse the effectiveness of myofascial self-release methods and the use of the tool in the development of strength indicators in the tibia extensor muscles. Instrumental assessment of muscle function was performed on a REV 9000, Technogym<sup>R</sup>, Italy. The subjects of our study were twenty healthy fitness athletes aged between 20 and 23 years. A set of strength exercises was developed, consisting of 10 exercises focused on increasing the muscle strength of tibia extensor muscles. For the experimental group self-massage with a roller was applied. When applying strength-development exercises with a set of self-release, the dynamics of maximum strength results are as follows: the force balance of the dominant and the non-dominant leg in the control group before ( $p=0.001$ ) and after ( $p=0.02$ ) the experiment, and in the experimental group before ( $p=0.01$ ) and after ( $p=0.02$ ) the experiment remained unchanged – no significant changes were observed in the results between the groups; - positive dynamics in strength changes were observed for the dominant leg between the control group ( $p=0.08$ ) and the experimental group ( $p=0.37$ ) before and after the experiment. The positive increase in the results is in favour of the experimental group, although there are no significant statistical differences in the results of the control group. On the other hand, no differences in the strength dynamics of the non-dominant leg were found.*

**Keywords:** *dynamometry, fitness, maximum strength, myofascial self-release, tibia extensor muscles*

## Introduction

It is believed that self-massage is very useful for athletes who regularly must overcome heavy loads during training and competition. Its purpose is to prepare the body for performing physical exercises, as well as to prevent injuries and fight against fatigue (Zeidlers, 2009).

Massaging with a massage roller has been observed to stimulate nerve impulses in humans, thus potentially increasing strength and performance

(Macgregor, Fairweather, Bennett, & Hunter, 2018). In a study on the effects of massage rollers on the performance and recovery, the authors concluded that in the short term, rolling before an exercise or a task will improve muscle elasticity without affecting muscle performance (Wiewelhove, Döweling, Schneider, Hottenrott, Meyer, Kellmann, & Ferrauti, 2019).

Using self-massage with rolling has been shown to accelerate the recovery process to restore strength properties. Moreover, rolling with self-massage rollers after the active part of the class showed a positive effect on strength indicators (Zorko, Škarabot, García-Ramos, & Štirn, 2016; Fleckenstein, Wilke, Vogt, Banzer, 2017). Using it as a recovery tool, participants in one study experienced a reduction in muscle soreness and an increase in strength properties (Larson, 2014). If used successfully to treat muscle injuries and pain, myofascial self-massage may also improve muscle mechanical properties, range of motion, and strength indicators, reducing muscle stiffness and fatigue (Wiewelhove et al., 2019; Macgregor et al., 2018; Poppendieck, Wegmann, Ferrauti, Kellmann, Pfeiffer, & Meyer, 2016; Aboodarda, Spence, & Button, 2015; Pearcey, Bradbury-Squires, Kawamoto, Drinkwater, Behm, & Button, 2015; Hill, Howatson, van Someren, Leeder, & Pedlar, 2014; Sullivan, Silvey, Button, & Behm, 2013; Hunter, Watt, Watt, & Galloway, 2006). The self-massage roller is claimed to be used to help increase blood flow and circulation to specific areas of the muscles, helping to increase muscle elasticity, flexibility and joint range of motion (Graven-Nielsen, Lund, Arendt-Nielsen, & Danneskiold-Samsøe, 2002).

Studies (Sullivan et al., 2013; Halperin, Aboodarda, Button, Andersen, & Behm, 2014; Zorko et al., 2016) found that rolling with self-massage rollers slightly but significantly increased strength indicators in the tibia extensor muscles in men. However, such a factor was not observed in women. It was concluded that this could possibly be related to the differences in muscle mass between women and men.

Therefore the aim of our research was to determine the effectiveness of myofascial self-massage method and tool application in developing strength indicators in the tibia extensor muscles for healthy fitness athletes.

## **Methodology**

A dynamometric device “REV 9000” (*Technogym<sup>R</sup>, Italy*) was used as part of dynamometric testing. It obtained the maximum strength indicators (Nm) of the participants in the isometric mode before and after the experimental part - performing the exercises. Maximum strength indicators were determined for the right and left leg of the research participant. At the beginning of dynamometry, a lever was installed.

The participant sat in the seat of the REV 9000 and a loop was placed over the ankle part, and the lever itself was mounted parallel to tibia. After preparatory work, continuous passive movements (CPM) at 100°/sec with set amplitude

parameters from 14° to 93° (ROM) degrees were performed to warm up the leg for maximum force load in dynamometry. After the participants prepared to perform maximum force expression in the isometric mode with the knee joint flexed at an angle of 90° and performed 3 sets to obtain the indicators. A 20-second break was observed between the attempts. As a result, the maximum strength indicators (Nm) were obtained. After obtaining the maximum strength indicators, continuous passive movements (CPM) were performed for the purpose of cooling down. During the practical part of the study, to determine the use of the myofascial self-massage method for increasing exercise performance, a control group (CG) and an experimental group (EG) was formed.

The research contingent were men. There were 20 fitness representatives who engaged in physical activities regularly, at least 3 times a week, aged between 23 and 25 years. Both study groups were instructed to perform 3 of the 10 selected exercises for developing the leg muscles each time during the physical exercise tests. The number of times to perform each exercise varied from 8 to 20 repetitions and 2-3 sets. At the beginning of the stage, the number of times was smaller and with each time, over a period, it was increased, increasing the volume and intensity of the load, depending on the adaptation abilities and performance of the athletes.

The following exercises were selected for the strength-building: lower leg extension in the exercise machine with resistance; squats from a sitting position on a bench and standing up, holding a weight in front; squats with a big exercise ball behind the back and against the wall; squats in the Smith machine, bringing the feet forward in the starting position; lunge with one leg, with the rear leg on an elevation; stepping forward into a lunge with narrow legs and hands holding dumbbells downwards; climbing on an elevation with one leg (on a box); squats on tiptoes, bending the upper body backwards; squat with a barbell on one's back, feet hip-width apart; squat with a barbell in front.

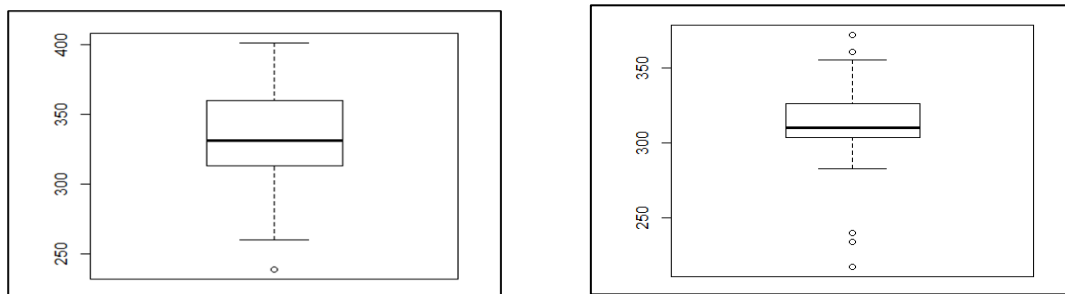
Separately, the experimental group underwent self-massage with a roller after performing strength exercises. These exercises included rolling with a roller and shin flexion (bending), pressing on the most sensitive area of the quadriceps in the thigh.

The "R-Studio" computer programme was used to perform the statistical analysis.

### **Results of the research**

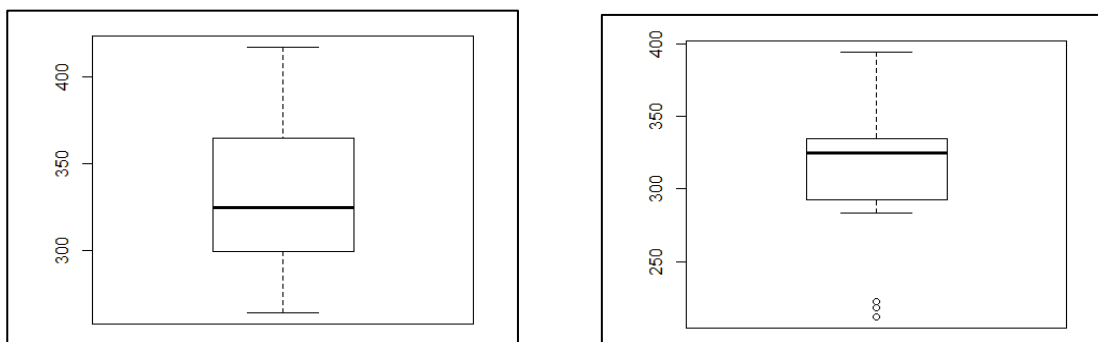
The results obtained during the data processing stage were divided into groups of dominant and non-dominant leg. The collected average maximum strength indicators in the control group ( $n = 20$ ) before the application of strength exercises for the dominant leg is  $333.71 \pm 44.75$  Nm ( $p=0.59$ ), and for the non-dominant leg  $307.42 \pm 38.96$  Nm ( $p=0.02$ ). See Figure 1 for the graphical

distribution of the maximum strength indicators in the control group for the dominant and non-dominant leg.



**Figure 1 Graphical distribution of the control group data on maximum strength indicators (Nm) for the dominant (left graph) and non-dominant (right graph) leg prior to the experiment (created by the authors)**

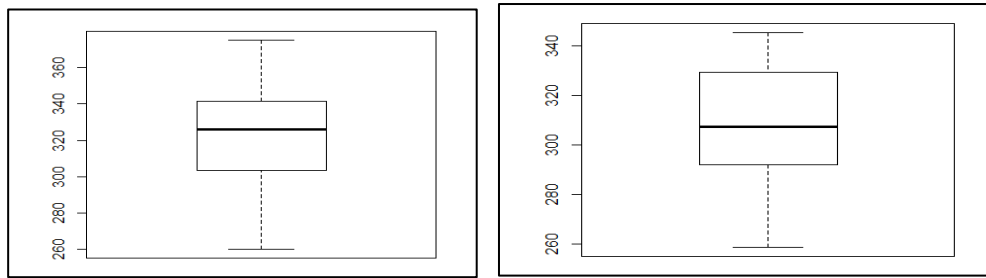
The summarized average strength indicators ( $n = 20$ ) in the experimental group before applying strength and self-massage for the dominant leg is  $330.65 \pm 46.44$  Nm ( $p = 0.44$ ), and for the non-dominant leg:  $313.34 \pm 47.71$  Nm ( $p = 0.03$ ). For the graphical distribution of the maximum strength indicators in the experimental group for the dominant and non-dominant leg, see Figure 2.



**Figure 2 Graphical distribution of the experimental group data on maximum strength indicators (Nm) for the dominant (left graph) and non-dominant (right graph) leg prior to experiment (created by the authors)**

Comparing the obtained results ( $n = 20$ ) for the dominant leg before the experiment in the control group ( $333.71 \pm 44.75$  Nm) and the experimental group ( $330.65 \pm 46.44$  Nm), the initial indicators in the control group are 3.06 Nm higher than in the experimental group. In this case, no statistically significant differences in results were found ( $p = 0.87$ ). The pre-experimental average maximum strength indicators of the dominant leg were not statistically different between the control group and the experimental group.

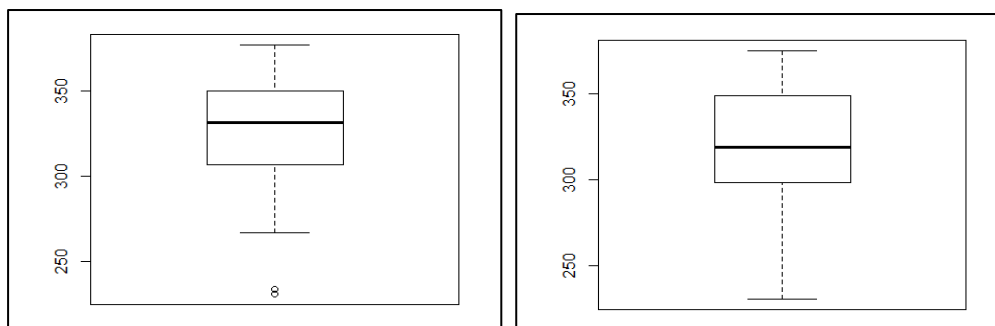
Comparing the obtained results ( $n = 20$ ) for the non-dominant leg before the experiment in the control group ( $307.42 \pm 38.96$  Nm) and the experimental group ( $313.34 \pm 47.71$  Nm), the initial average indicators in the control group are 5.92 Nm lower than in the experimental group. No statistically significant differences were found between the average indicators of the groups ( $p = 0.32$ ). The maximum strength indicators of the non-dominant leg before the experiment were not statistically different between the control group and the experimental group.



*Figure 3 graphical distribution of the control group data on maximum strength indicators (Nm) for the dominant (left graph) and non-dominant (right graph) leg post-experiment (created by the authors)*

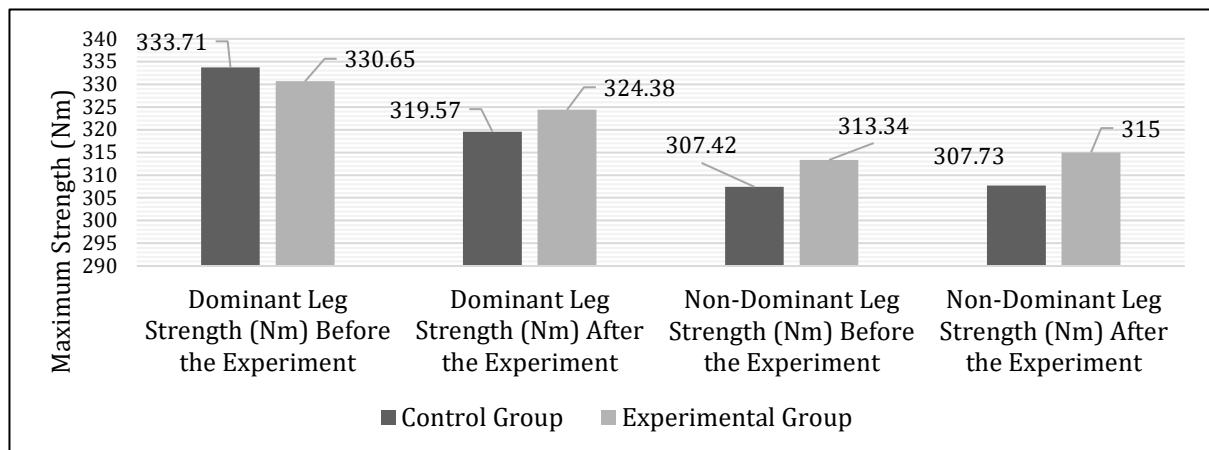
The average indicators of maximum strength (Nm) in the control group after applying strength exercises for the dominant leg are  $319.57 \pm 33.9$  Nm ( $p = 0.14$ ), and  $307.73 \pm 27.76$  Nm ( $p = 0.12$ ) for the non-dominant leg. For the analysed data on the graphical dispersion of maximum strength indicators in the control group for the dominant and non-dominant leg (see Figure 3).

The average maximum strength indicators (Nm) in the experimental group after strength exercises and self-massage method application for the dominant leg is  $324.38 \pm 40.83$  Nm ( $p=0.03$ ) and  $315 \pm 41.44$  Nm ( $p=0.24$ ) for the non-dominant leg. For the analysed data on the graphical dispersion of the maximum strength indicators in the experimental group for the dominant and non-dominant leg (see Figure 4).



*Figure 4 Graphical distribution of the experimental group data on maximum strength indicators (Nm) for the dominant (left graph) and non-dominant (right graph) leg post-experiment (created by the authors)*

Comparing the obtained results ( $n = 20$ ) for the dominant leg before the experiment in the control group ( $333.71 \pm 44.75$  Nm) and the experimental group ( $330.65 \pm 46.44$  Nm), the initial indicators in the control group are 3.06 Nm higher than in the experimental group. In this case, no statistically significant difference in results was found ( $p = 0.87$ ). The pre-experimental average maximum strength indicators for the dominant leg were not statistically different between the control group and the experimental group. Comparing the obtained results ( $n = 20$ ) for the non-dominant leg before the experiment in the control group ( $307.42 \pm 38.96$  Nm) and the experimental group ( $313.34 \pm 47.71$  Nm), the initial average indicators in the control group are 5.92 Nm lower than in the experimental group. No statistically significant differences were found between the group average indicators ( $p = 0.32$ ). The maximum strength indicators of the non-dominant leg before the experiment were not statistically different between the control group and the experimental group. Comparing the obtained results ( $n = 20$ ) for the dominant leg after the experiment in the control group ( $319.57 \pm 33.9$  Nm) and the experimental group ( $324.38 \pm 40.83$  Nm), the final indicators in the control group are 4.81 Nm lower than in the experimental group. Thus, it was found that there is no statistically significant difference in the average indicators between these groups ( $p = 0.76$ ). The maximum strength indicators of the dominant leg after the experiment did not differ between the control group and the experimental group. Comparing the obtained results ( $n = 20$ ) of the non-dominant leg after the experiment in the control group ( $307.73 \pm 27.76$  Nm) and the experimental group ( $315 \pm 41.44$  Nm), the final indicators in the control group are 7.27 Nm lower than in the experimental group. This means that there is no statistically significant difference between the groups ( $p = 0.62$ ). Post-experimental indicators of the non-dominant leg did not differ between the control group and the experimental group. The overall results show that after the experiment, when analysing the average indicators of the control group and the experimental group for the dominant and non-dominant leg, the indicators between the groups are not statistically different from each other. Comparing the maximum strength indicators in the tibia extensor muscles before and after the experiment in the control group and the experimental group, the applied self-massage method, combined with strength-building exercises, did not affect the changes in the maximum strength results before and after the experiment. For a summary of all results and analysis in this aspect, see Figure 5.



**Figure 5 Dynamics of maximum strength indicators before and after the experiment for the dominant and non-dominant leg between the control group and the experimental group (created by the authors)**

Comparing the results in the control group ( $n = 20$ ) before the experiment for the dominant leg ( $333.71 \pm 44.75$  Nm) and the non-dominant leg ( $307.42 \pm 38.96$  Nm), the average maximum strength indicators of the dominant leg are 26.29 Nm higher than those of the non-dominant leg. Thus, statistically significant differences have been found between the average indicators of the groups ( $p = 0.001$ ). This shows that the dominant leg is stronger than the non-dominant leg in the initial indicators of the study participants in the control group. Comparing the results of the control group ( $n = 20$ ) after the experiment for the dominant leg ( $319.57 \pm 33.9$  Nm) and the non-dominant leg ( $307.73 \pm 27.76$  Nm), the maximum strength indicators of the dominant leg are 11.84 Nm higher than for the non-dominant leg. Therefore, statistically significant differences have been found between the average indicators of the groups ( $p = 0.02$ ). This shows that the dominant leg remained as the strong leg and the non-dominant leg as the weakest leg in the indicators of the control group. In the indicators of the control group before and after the experiment, the balance of the maximum strength indicators of the dominant and non-dominant leg has remained unchanged (this means that the dominant leg has remained as the strongest leg and the non-dominant leg as the weakest leg). Comparing the results of the experimental group ( $n = 20$ ) before the experiment for the dominant leg ( $330.65 \pm 46.44$  Nm) and the non-dominant leg ( $313.34 \pm 47.71$  Nm), the average maximum strength indicators of the dominant leg are 17.31 Nm higher than those of the non-dominant leg. Comparing these results, statistically significant differences were found between the average indicators of the groups ( $p = 0.01$ ). This shows that the dominant leg was stronger than the non-dominant leg in the initial indicators of the study participants in the experimental group. Comparing the results of the experimental group ( $n = 20$ ) after the experiment for the dominant leg ( $324.38 \pm 40.83$  Nm) and

the non-dominant leg ( $315 \pm 41.44$  Nm), the average maximum strength indicators of the dominant leg are 9.38 Nm higher than those of the non-dominant leg. Thus, statistically significant differences have been found between the group average indicators ( $p = 0.02$ ). This shows that the method used during the experiment did not affect the maximum strength indicators. In the indicators of the experimental group before and after the experiment, comparing the dominant and non-dominant leg, differences in results have been found. This shows that the balance of the maximum strength indicators of the legs has remained unchanged (this means that the dominant leg before and after the experiment has remained as the strongest leg and the non-dominant leg as the weakest leg). Comparing the end results of the maximum strength in the control group and the experimental group, the applied self-massage method, combined with strength-building exercises, did not affect the balance of the maximum strength of the tibia extensor muscles between the dominant and non-dominant leg. For a summary of all results and analysis for this case (see Figure 6).

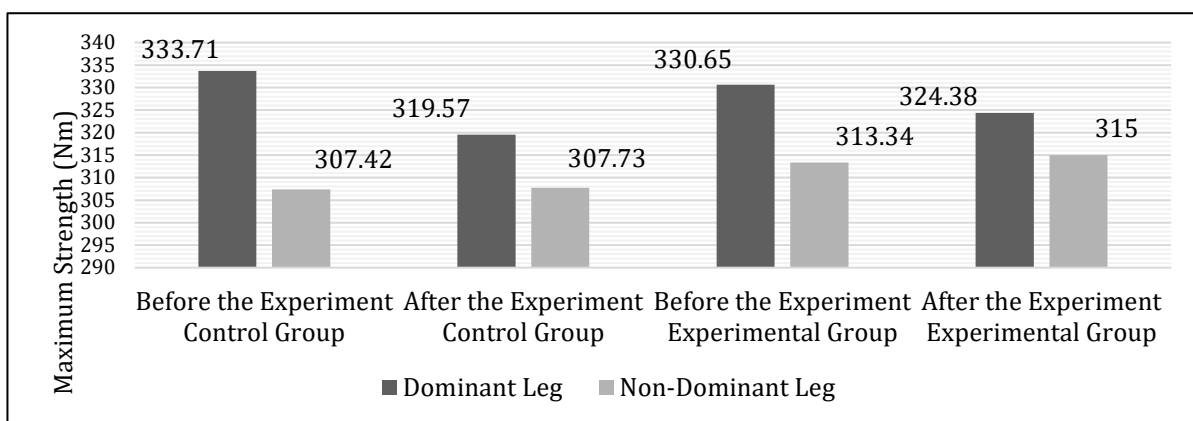


Figure 6 Comparison of the dominant and non-dominant leg in the control group and the experimental group before and after the experiment (created by the authors)

Comparing the obtained results for the dominant leg in the control group before ( $333.71 \pm 44.75$  Nm) and after the experiment ( $319.57 \pm 33.9$  Nm), the average indicators of maximum strength before the experiment are 14.14 Nm higher than after the experiment. It was found that there were no statistically significant differences between the average indicators of the groups ( $p = 0.08$ ). In this case, it should be noted that the result ( $p = 0.08$ ) is close to the limit of statistical reliability ( $p < 0.05$ ). The maximum strength indicators of the dominant leg in the control group have decreased after the experiment. However, the maximum strength of the dominant leg in the control group before and after the experiment was not statistically different.

Comparing the obtained results for the dominant leg in the experimental group before ( $330.65 \pm 46.44$  Nm) and after the experiment ( $324.38 \pm 40.83$  Nm),



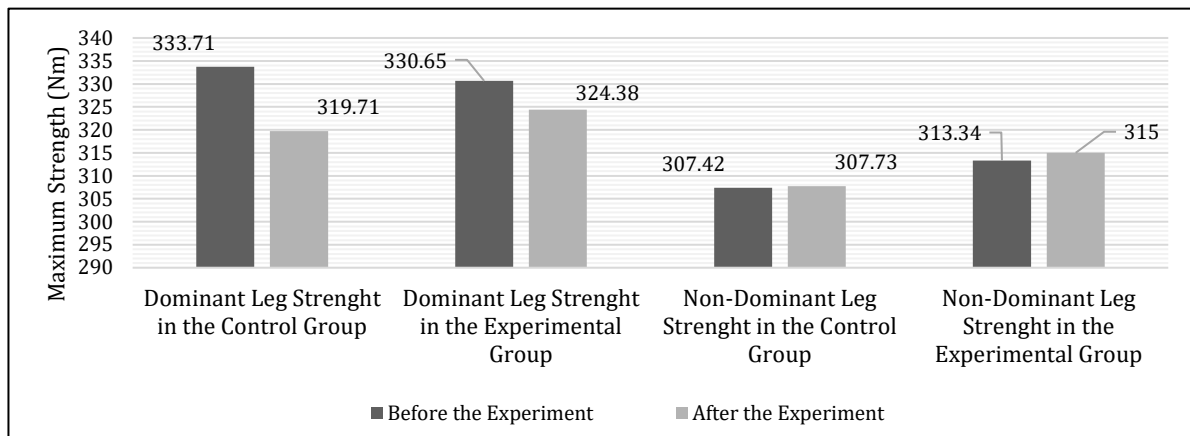
the average indicators of maximum strength before the experiment are 6.27 Nm higher than after the experiment. Thus, there are no statistically significant differences between the average indicators of the groups ( $p = 0.37$ ).

The maximum strength indicators of the dominant leg in the experimental group before and after the experiment are not statistically different. In any case, the maximum strength indicators of the dominant leg have decreased, and only the control group has seen more pronounced changes in the results. The overall results show that there is no difference between the dominant leg indicators in the control group and the experimental group before and after the experiment. The author notes that in the case of the control group, the strength indicators of the dominant leg after the experiment (by 4.24%) have decreased more than the experimental group (by 1.9%) after the experiment. The results show positive dynamics of changes in average maximum strength indicators in favour of the results in the experimental group, although the results in the control group did not show statistically reliable differences.

Comparing the obtained results for the non-dominant leg in the control group before ( $307.42 \pm 38.96$  Nm) and after the experiment ( $307.73 \pm 27.76$  Nm), the average maximum strength indicators before the experiment are 0.31 Nm lower than after the experiment. There are no statistically significant differences between the average indicators of these groups ( $p = 0.92$ ). The average maximum strength indicators of the non-dominant leg in the control group before and after the experiment are not statistically different.

Comparing the obtained results in the experimental group for the non-dominant leg before ( $313.34 \pm 47.71$  Nm) and after the experiment ( $315 \pm 41.44$  Nm), the average maximum strength indicators before the experiment are 1.66 Nm lower than after the experiment. Therefore, there are no statistically significant differences between the average indicators of the groups ( $p = 1$ ). The average indicators of the maximum strength for the non-dominant leg in the experimental group before and after the experiment did not change statistically.

The overall results show that the indicators for the non-dominant leg in the control group and the experimental group before and after the experiment are not statistically different from each other. When comparing the maximum strength indicators in the tibia extensor muscles in the control group and the experimental group, the applied self-massage method, combined with strength-building exercises, did not affect the changes in the maximum strength results for the non-dominant leg, but positive changes in the strength of the dominant leg were noticed between the control group and the experimental group. The indicators in the control group have greater statistically reliable differences ( $p = 0.08$ ) than the experimental group ( $p = 0.37$ ).



**Figure 7 Dynamics of maximum strength indicators in the control and experimental groups for the dominant and non-dominant leg before and after the experiment**

Although there is no statistical reliability between the average indicators, self-massage has contributed to more positive power dynamics for the dominant leg. For a summary of the maximum strength results and an analysis of this situation (see Figure 7).

### Conclusions

The average maximum strength indicators for the dominant leg and for the non-dominant leg in both groups differs after the experiment, and the dominant leg remains as a strong leg. There is no statistically significant difference in the average maximum strength indicators of the dominant leg and non-dominant leg before and after the experiment in both groups.

No statistically significant differences were found between the control group and the experimental group in the average maximum strength indicators of the dominant leg and the non-dominant leg after the experiment.

The applied self-massage method combined with strength-building exercises did not affect changes in maximum strength results, did not affect the balance of the maximum strength of the tibia extensor muscles between the dominant and non-dominant leg, did not affect the change in maximal strength results for the non-dominant leg.

Positive strength changes in the strength of the dominant leg were noticed between the control group and the experimental group after the experiment. Self-massage contributed to more positive power dynamics for the dominant leg, although there were no statistically significant differences before and after the experiment.

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