Journal of Physical Education and Sport ® (JPES), 14(4), Art 69, pp. 455 - 458, 2014
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Effectiveness of static and dynamic stretching prior to speed and speed-strength load

PUPIŠ MARTIN[1] PIVOVARNIČEK PAVOL[2] PUPIŠOVÁ ZUZANA[3] TOKÁROVÁ MARTINA[4], MORAVČÍK JURAJ1[5]
[1,2,3,4,5]Department of Physical Education and Sports, Faculty of Arts, Matej Bel University, SLOVAK REPUBLIC

Published online: December 30, 2014
(Accepted for publication November 15, 2014)

DOI:**10.7752/jpes.2014.04069;**

Abstract:
The aim of the study is to compare the impact of static and dynamic stretching on performance in terms of speed and speed-strength abilities. The studied subject was a group of professional ice hockey players (n = 12, goalkeeper = 1, defenders = 3, centres = 8, age = 22.9±3.4 years, height = 184.8±7.4 cm, weight = 86.2±7.6 kg) playing in the highest-level ice hockey competition in the 2011/2012 year of competition. The impact of static and dynamic stretching was determined via speed and speed-strength ability indicators (lower limb frequency velocity, lower limb explosive and dynamic strength). The average result of the players in terms of lower limb frequency velocity after static stretching was 69.7±2.9 taps, whereas after dynamic stretching we obtained 73.4±4.2 taps; There is therefore, an important difference between them ($t = 4.031$, $p<0.05$; $d = 1.15$ – large effect). In terms of the lower limb explosive strength, the average result after static performance was 41.1±3.8 cm in squat jump (SJ) and 45.3±3.6 cm in countermovement jump (CMJ). The same indicator after dynamic stretching was affected has shown the following results – 43.5±3.6 cm in SJ and 47.3±3.5 cm in CMJ, showing an important difference again (SJ: $t = 6.437$, $p<0.05$, $d = 1.86$ – large effect; CMJ: $t = 4.356$, $p<0.05$, $d = 1.26$ – large effect). Testing the lower limb dynamic strength, we obtained the average result of 27.5±5.9 cm after the static and 33.3±4.7 cm after the dynamic stretching in plyometric jump ($t = 6.756$, $p<0.05$, $d = 1.95$ – large effect). The study proved distinctively higher values of all three studied indicators of speed and speed-strength abilities after dynamic more than static stretching.
Key words: explosive strength, frequency velocity, ice hockey, vertical jump.

Introduction

The problem of a suitable warm-up and limbering up is much discussed in sports; however it still remains unclear. At the end of the last century, the proprioceptive neuromuscular facilitation stretching method became widely used. Although it has positive effects on joint mobility, it has not been sufficiently proven that it has the same effects on an athlete immediately before the load activity. Currently, the pre-performance load activities stress an intensified warm-up and a subsequent dynamized limbering up.

The effectiveness of different types of warm-ups and stretching is extensively discussed in sports. Our study compares the impact of static and dynamic stretching on the speed-strength performance of young ice hockey players. In terms of functionality, Kampmiller & Vanderka (2008) states that we must realize that the majority of sports use the stretch-shortening cycle in sports practice. Yamaguchi & Ishii (2005) confirmed that there is no difference in the strength performance of an athlete applying the static or no stretching prior to the load. However, there is a significant change when dynamic stretching is applied ($p<0.01$). After the static or no stretching, the power of 1788.5±85.7 W / 1784.8±108.4 W was recorded while after dynamic stretching it was 2022.3±121.0 W. Fletcher & Jones (2004) obtained similar results, ascribing them to the loss of elastic energy. Many other studies have come to the same conclusions (Herda et al., 2008; Cacek & Bubníková, 2009; Cacek, Hlavoňová & Michálek, 2009; Gelen, 2010). Nonetheless, Little & Williams came up with different results in this matter. They recorded no significant differences between the impact of static and dynamic stretching on the vertical jump, 10 m and 20 m sprint. Although Jaggers et al. (2008) noticed the advantages of dynamic stretching in comparison with other stretching methods, they disputed its effectiveness in the vertical jump; however, they assumed a better performance after consequent jumps, which could be assigned also to sprint speed.

It is important to stress that the intensity of dynamic stretching has not a negligible impact on subsequent speed-strength performance. In this context, Fletcher (2010) confirmed that heart rate increase and consequent core temperature increase (which he measured in the eardrum) are essential to dynamic stretching.

The aim of the study was to compare the impact and effectiveness of static and dynamic stretching in

Corresponding Author PIVOVARNIČEK PAVOL, E-mail: Pavol.Pivovarnicek@umb.sk

top-level ice hockey players prior to a load consisting of the frequency velocity, lower limb explosive strength and lower limb dynamic strength.

Method

Subject characteristics

The studied subject was a group of top-level ice hockey players playing in the 2011/2012 competition year (n = 12, goalkeeper = 1, defenders = 3, centres = 8, age = 22.9±3.4 years, height = 184.8±7.4 cm, weight = 86.2±7.6 kg).

Measurement taking

Lower limb frequency velocity test

The lower limb frequency velocity was measured with the FiTROtapping device (FiTRONIC, Bratislava, Slovak republic) consisting of two contact switch mattresses placed and fixed on the floor, connected by means of a USB interface to the computer and special software. At the beginning of the measurement, the hockey player was in a standing position behind the mattresses. Then, alternating the left and right foot, his task was to effectuate the maximum of taps on the mattresses throughout 6 seconds. The results were evaluated by the number of taps of both feet effectuated on the FiTROtapping contact mattresses in 6 seconds. The measurements were carried out three times with the accuracy of one tap. The best of three attempts was used for the study.

Lower limb explosive strength test

The lower limb explosive strength was assessed with the Mytoest PRO device (Myotest, Switzerland) using two types of vertical jumps – the squat jump (SJ) and the countermovement jump (CMJ). The performance criterion was the jump height in centimetres (cm) with accuracy of 0.1 cm. The best of the three CMJ and SJ attempts was taken into consideration.

Lower limb dynamic strength test

The lower limbs dynamic strength was computed by the Mytoest PRO device (Myotest, Switzerland) using 10 consequent vertical jumps. The performance criterion was the average jump height of ten jumps in centimetres (cm) with an accuracy of 0.1 cm.

The above mentioned tests enabled us to diagnose the level of the studied motion performances after static and dynamic stretching was applied. By means of statistical analysis, we assessed the difference between the static and dynamic stretching effect on the current level and preparedness of the subjects in terms of the studied speed and speed-strength motion performances.

Measurement organisation

The measurements were taken during the 2011/2012 year of competition from January 18th, 2012 to February 22th, 2012. The measurements were carried out in the Fitaréna training centre in Banská Bystrica (Slovak republic) under constant temperature and humidity conditions on Wednesdays, the day after the Slovak top-level ice hockey league competitions. Each of the players attended 6 measuring sessions throughout 6 weeks, 3 of them after static stretching (18th January, 1st February and 15th February) and the other 3 after dynamic stretching (25th January, 8th February, 22th February). The results of the speed and speed-strength tests after the application of static and dynamic stretching were averaged from the 3 effectuated measurements in the case of static and dynamic stretching. The warm-up and limbering up consisted of the same features before every measurement. The subjects warmed up on the Lifefitness stationary bike (500 m) and then made respective stretching exercises in the identical order each time under the supervision of the examiner. Prior to the measurement taking, the subjects were always briefly explained to and demonstrated the test course.

Static stretching:

- 10-15 s of stretching exercise
- 5-10 rest interval between each exercise
- Each exercise was done twice
- Muscle stretching with intensity degree 1-3 (mild discomfort)

Dynamic stretching:

- Standard methodology of dynamic stretching was observed – 8 repetitions of 5 s duration
- 2-5 s rest interval between each exercise
- Each exercise was repeated 6-10 times
- Muscle stretching with intensity degree 1-3 (mild discomfort)

The research was approved by the Ethical Committee of Matej Bel University in Banská Bystrica (Slovak republic).

Data Analyses

We chose the following descriptive statistics characteristics – for measurements of central tendency we used the arithmetic mean (x) and for measures of variability the standard deviation (SD). The Paired-Samples T test was used to establish the significance of the differences of the indicators (frequency velocity; lower limbs explosive strength – squat jump, countermovement jump; lower limb dynamic strength – plyometric jump) after static and dynamic stretching. The normality of the distribution of each indicator was determined through the Shapiro-Wilk test. In all statistical analyses, the rate of the type I error (alpha) was set at 0.05. The effect size of the means of each indicator was determined by Cohen's correlation coefficient *d*, calculated as the difference between two means divided by the standard deviation X_D/S_D (Starkweather, 2010). The obtained values were interpreted as follows: d = 0.20 – small effect, d = 0.50 – medium effect, d = 0.80 – large effect (Cohen, 1992). The statistical analysis was carried out by IBM® SPSS® Statistics V19 software (Statistical Package for Social Sciences).

Results and discussions

The first measured indicator was the lower limb frequency velocity (tapping). Ten of twelve players scored better after dynamic stretching, 1 player had the same results after both types of stretching and 1 player had better results after static stretching. The worst result delivered by 2 players after static stretching equalled 66 gait cycles. The best result was 81 gait cycles delivered by the player 5. His results showed the greatest difference between static and dynamic stretching. It was the difference of 10 taps in 6 seconds so he improved by 14.1% when applying dynamic stretching. After static stretching, the average result was 69.7±2.9 taps on the FiTROtapping in 6 seconds. After dynamic stretching it was 73.4±4.2 taps. Therefore, the statistical analysis showed that the players performed better (t = 4.031, p<0.05, d = 1.15 – large effect) after dynamic stretching than static stretching in terms of the frequency velocity (Table 1).

Table 1 Individual and average results of the players in the lower limb frequency velocity test. The table shows the number of taps effectuated on the FiTROtapping mattresses in 6 seconds after the static and dynamic stretching (n = 12).

Player	1	2	3	4	5	6	7	8	9	10	11	12	x±SD
SS	66	77	69	70	71	68	70	72	68	66	69	70	69.7±2.9
DS	73	79	75	76	81	78	70	75	66	69	71	74	73.4±4.2
Difference	7	2	6	6	10	10	0	3	-2	3	2	4	4.3±3.7*

SS – number of taps on FiTROtapping mattresses in 6 seconds after static stretching
DS – number of taps on FiTROtapping mattresses in 6 seconds after dynamic stretching
* – significance of differences p<0.05

In terms of lower limb explosive strength, all 12 subjects performed better in the squat jump test after dynamic stretching. The worst result was 32.5 cm, obtained after static stretching (more details in Table 2). The best result in this test was given by player 2 – 49.9 cm after dynamic stretching. The greatest difference between static and dynamic stretching was shown by player 3. It was 5.2 cm representing a 14.2% improvement. The player 10 displayed the smallest difference in this matter – 1 cm, representing a 2.3% improvement. The average result of the group after static stretching was 41.1±3.8 cm. After dynamic stretching, the average equalled 43.5±3.6 cm, making a significant difference of 2.3±1.3 cm (t = 6.437, p<0.05, d = 1.86 – large effect). This discovery is contrary to some former studies (Little & Williams, 2006; Jaggers et al., 2008, etc.), which stated that the application of dynamic stretching would not influence the height of the vertical jump (without countermovement).

Table 2 The individual and average results of the players in the lower limb explosive strength test. The table shows the height of the squat jump in centimetres (cm) after static and dynamic stretching (n = 12).

Player	1	2	3	4	5	6	7	8	9	10	11	12	x±SD
SS	41.0	47.9	36.7	34.5	41.7	40.4	36.9	43.6	42.1	44.0	40.1	44.7	41.1±3.8
DS	42.2	49.9	41.9	37.1	43.9	43.6	38.0	44.9	43.7	45.0	43.6	47.9	43.5±3.6
Difference	1.2	2.0	5.2	2.6	2.2	3.2	1.1	1.3	1.6	1.0	3.5	3.2	2.3±1.3*

SS –height of the vertical jump in the SJ test after static stretching
DS –height of the vertical jump in the SJ test after dynamic stretching
* – significance of differences p<0.05

The Countermovement jump (CMJ) tested the lower limb explosive strength (Table 3). After dynamic stretching, 10 of 12 players had better results and 2 players did not improve. After static stretching, no player improved. The worst result was 40.0 cm, obtained after static stretching. Player 2 scored the best in this test with 53.1 cm following dynamic stretching. Player 11 showed the greatest difference in results – 5.6 cm, e. g. a 13.2% improvement. The players 4 and 6 obtained no change in performances after static and dynamic stretching. The second smallest difference showed player 2 with a difference of a 0.7 cm – 1.3% improvement. The average result of the group after static stretching was 45.3±3.6 cm and 47.3±3.5 cm after dynamic stretching. That implies a 2.0±1.6 cm average improvement in the CMJ test, which is a significant difference (t = 4.356, p<0.05, d = 1.26 – large effect).

Table 3 Individual and average results of the players in the lower limb explosive strength test. The table shows the height of the countermovement jump in centimetres (cm) after static and dynamic stretching (n = 12).

Player	1	2	3	4	5	6	7	8	9	10	11	12	x±SD
SS	41.0	52.4	45.9	44.7	48.4	44.3	40.0	45.2	44.6	44.3	42.4	50.3	45.3±3.6
DS	43.4	53.1	47.2	44.7	51.6	44.3	42.1	46.2	47.8	46.9	48.0	52.1	47.3±3.5
Difference	2.4	0.7	1.3	0	3.2	0	2.1	1.0	3.2	2.6	5.6	1.8	2.0±1.6*

SS –vertical jump height in the CMJ test after static stretching
DS –vertical jump height in the CMJ test after dynamic stretching
* – significance of differences p<0.05

In the test of the lower limb dynamic strength – plyometric jump (PJ), all 12 players showed better results after the application of dynamic stretching (table 4). None of the players improved after static stretching. The worst result was the 21.3 cm reached after static stretching. Player 3 achieved the best result, 41.7 cm after dynamic stretching. The greatest difference in results – 10.0 cm, a 42.4% improvement – was obtained by player 2. The smallest difference in results after the application of static and dynamic stretching was observed in the case of player 4. It was only 0.4 cm, e. g. a 1.3% improvement. The average result after static stretching was 27.5±5.9 cm and 33.3±4.7 cm after dynamic stretching, thus an important difference, 5.8±3.0 cm ($t = 6.756$, $p<0.05$, $d = 1.95$ – large effect).

Table 4 Individual and average results of the players in the lower limb dynamic strength test. The table shows the height of the plyometric jump in centimetres (cm) after static and dynamic stretching (n = 12).

Player	1	2	3	4	5	6	7	8	9	10	11	12	x±SD
SS	39.1	23.6	35.7	31.6	27.7	25.1	21.6	28.2	19.3	22.0	29.4	26.3	27.5±5.9
DS	39.7	33.6	41.7	32.0	34.6	30.8	29.1	36.9	27.7	26.2	36.0	31.0	33.3±4.7
Difference	0.6	10.0	6.0	0.4	6.9	5.7	7.5	8.7	8.4	4.2	6.6	4.7	5.8±3.0*

SS –average vertical jump height in the PJ test after static stretching
DS –average vertical jump height in the PJ test after dynamic stretching
* – significance of differences p<0.05

Conclusions

The results of the study point to the differences of the impact in warming-up and limbering up prior to the speed and speed-strength load. The results prove that it is justified to favour dynamic stretching prior to this type of load. However, the study lacks a greater number of tested subjects (n = 12). Nonetheless, in all studied indicators, the results of the study proved the substantially better preparedness and performance of the group of top-level ice hockey players prior to the speed and speed-strength load after the application of dynamic rather than static stretching. On the basis of the study in agreement with many authors (Fletcher & Jones, 2004; Herda et al., 2008; Jaggers et al., 2008; Cacek & Bubníková, 2009; Cacek, Hlavoňová & Michálek, 2009; Gelen, 2010) we consider dynamic stretching to be the most suitable warm-up method prior to speed-strength types of load.

Acknowledgement

The study is a part of the researched project VEGA 1/0414/15.

References

Cacek, J. & Bubníková, H. (2009). *Statický versus dynamický strečink*. Praha, CZ: Atletika. Česká atletika s.r.o.
Cacek, J., Hlavoňová, Z. & Michálek, J. (2009). *Warm up – "Quo vadis"*. Praha, CZ: Atletika. Česká atletika s.r.o.
Cohen, J. (1992). *Statistics a power primer*. Psychology Bulletin, *112*(1), 115-159.
Fletcher, I. M., & Jones, B. (2004). The effect of different warm-up stretch protocols on 20 meter sprint performance in trained rugby union players. *J Strength Cond Res*, *18*(4), 885-888.
Fletcher, I. M. (2010). The effect of different dynamic stretch velocities on jump performance. *Eur. J. Appl.Physiol*, *109*(3), 491-498.
Gelen, E. (2010). Acute effects of different warm-up methods on sprint, slalom dribbling, and penalty kick performance in soccer players. *J Strength Cond Res*, *24*(4), 950-956.
Herda, T. J., Cramer, J. T., Ryan, E. D., McHugh, M. P., & Stout, J. R. (2008). Acute Effects of Static versus Dynamic Stretching on Isometric Peak Torque, Electromyography, and Mechanomyography of the Biceps Femoris Muscle. *J Strength Cond Res*, *22*(3), 809-817.
Jaggers, J. R., Swank, A. M., Frost, K. L., & Lee, C. D. (2008). The acute effects of dynamic and ballistic stretching on vertical jump height, force, and power. *J Strength Cond Res, 22*(6), 1844-1849.
Kampmiller, T., & Vanderka, M. (2008). Cyklus natiahnutia a skrátenia. *Športový pohyb z hľadiska distribúcie energie, práce a výkonu*. Bratislava, SK: ICM Agency.
Little, T., & Williams, A. G. (2006). Effects of differential stretching protocols during warm-ups on high speed motor capacities in professional soccer players. *J Strength Cond Res*, *20*(1), 203-207.
Starkweather, J. (2010). *Module 8: Introduction to the t tests*. [online], http://www.unt.edu/rss/class/Jon/ISSS_SC/Module008/isss_m8_introttests/node3.html
Yamaguchi, T., & Ishii, K. (2005). Effects of static stretching for 30 seconds and dynamic stretching on leg extension power. *J Strength Cond Res*, *19*(3), 677-683.