



The effect comparison of foam rolling and dynamic stretching on performance in motion tests by young volleyball players: a pilot study

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Abstract

Introduction: The aim of the pilot study was an effect comparison of stretching between foam rolling and dynamic stretching on performance in motion tests by young volleyball players. **Methods:** 1. Experimental sample – ES_{FR} (n=8, age = 13.4±0.5 years, height = 173.8±7.7 cm, weight = 59.8±7.1 kg) absolved 6 measurements of indicators of stretching with foam rolling during 6 weeks. 2. Experimental sample – ES_{DS} (n=8, age = 13.4±0.5 years, height = 174.5±9.5 cm, weight = 59.4±11.0 kg) absolved dynamic stretching. We had determined the stretching effect between ES_{FR} and ES_{DS} by comparison of performance in tests: spike jump (SS), block jump (BS) E-test (ET), run to cones (RC), throw with 1 kg ball (H2), sit and reach test (SR) and sit-ups (SU). **Results:** The most important determination was that better level of stretching presented in performance and it was determined in RC in two examples with medium effect and in three examples with large effect in behalf of ES_{FR}. By contrast, one example from ES_{DS} in parameter PS had better level of stretching with medium effect and one example with medium effect in H2. In other parameters (BS, SS, SU and ET) were the differences only small or none between ES_{FR} and ES_{DS}. **Conclusion:** The results of the pilot study indicate that using of foam rolling and dynamic stretching can have different influence on the level of stretching and preparation of young volleyball players. These results must be verified on larger experimental sample.

Keywords: movement, performance, volleyball, dynamic stretching, foam rolling

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INTRODUCTION

The aim of stretching is to prepare the player to maximize his performance [1,2]. In generally, the stretching takes 5 to 10 minutes and involves aerobic activity with low intensity, such as running up (double quick), the stretching exercises (dynamic, static stretching and so on) and finally specific activities (exercises) of individual sport [3]. In generally, such activity is a recommended method of body preparation for endurance in training [4,5]. The aim of stretching exercises in warm up is to increase articular mobility, to decrease resistance for myotaxis, and then it is possible to achieve better movement and higher performance [6,7]. More authors [8,9] mention that the impact of stretching goes together with mechanical (e.g., viscoelastic deformation, plastic deformation of connective tissue), also with nerve (e.g., neuromuscular relaxation, modification of sensation) factors.

There are also physiological processes in sportsman's organism. The central and peripheral mechanisms adjust to required level during increase of endurance. This process is controlled by neurohormonal way [10]. Physiological signification of stretching consists in increase of function of vegetative nervous organs, reduction of sudden disruption of homeostasis and supply of nutrients and oxygen [11]. The important signification has activating and optimization of irritation of CNS. This process becomes evident indirectly by increased hyperemia of organism following a rising of hearth frequency [12], mobilization of metabolic reactions so that comes to releasing of energy from cells and increasing of irritability of tissues [13], increasing of body and muscle temperature about 1-2°C [14], concentration of lactate in organism, changes of blood gases, changes in kinetics of oxygen intake and intensity of phosphorylation [1]. In stretching toning of muscles is very important, event. post-activation potential. According to post-activation potential, it comes to muscle stimulation that reflects to increase of muscle and sport performance. As we mentioned above, it follows that post-activation potential has influence on physiological and neural mechanisms [15]. Activation of fast glycolytic muscle fibers occurs by stretching after force or speed-force loading and it comes to increased contractibility of muscles. The result is higher irritability and contraction speed [16].

Currently we use different types of stretching, for e.g. static stretching, dynamic stretching, ballistic stretching, and proprioceptive neuromuscular facilitation. Some authors have a predominant view that performance of a sportsman is decreasing after static stretching [17,18] and even exhaustion is increasing [19]. Other studies [20,21,22] show that if static stretching is exercised 30 seconds, it has negligible or none negative influence on power formation. According to [23] exercising of static stretching 15-30 seconds is effective according to flexibility increase and range of motion. According to other studies [24,25,26] the application of dynamic stretching should have not influence on the height of single vertical jump by comparison with static stretching. Other studies tell that after dynamic stretching there is an improvement in muscle power by sportsmen [27], sprint [28,29] and jumps [30]. Many other studies point that application of dynamic stretching is suitable before loading [20,31,32]. It showed that it has significantly higher level of all studied indicators of speed, speed-force abilities and flexibility after application of dynamic stretching in comparison with static stretching [30,33].

Increasing of range of motion (ROM) with training, which is focused on flexibility, can positively influence health of the whole movement apparatus [3]. Flexibility of a sportsman can be influenced by many factors and one of those factors is limitation of fascia. The limitation of fascia can be caused by injury, disease or inflammation that decreases flexibility, power, coordination, endurance and can lead to physical pain [34]. We use myofascial techniques of release for alleviation of fascial restrictions [35]. Method of self-myofascial release (SMR) via a foam roller became in recent years very popular method for support of classical means of development of condition abilities. By using a foam roller in training, we use self-weight of a sportsman to apply pressure on soft tissues [36,37].

There are different views on using of a foam roller in stretching for increase of range of motion (ROM), flexibility and performance. According to [37] effects of a foam roller in stretching are rather small and partially negligible in performance in jumps, power and recovery, but in some cases they can be relevant (e.g. in increase of performance and flexibility in sprint or reduction of muscle pain). [36,38] came to similar conclusions. They compared stretching with the foam roller and dynamic stretching and they did not find out significant difference between these types of stretching in improvement of performance. Other author [39] wanted to find out an effect of myofascial release with

a foam roller on vertical jump and power, isometric power and agility, whereby they did not find out significant difference in any used test and using of the foam roller had not any influence on performance. By determination of effect of myofascial release via the foam roller on power and activation of knee extensor and ROM in knee-joint [35] discovered that using of a foam roller had not any significant influence on power of quadriceps or its activation, but it had significant influence on increasing of ROM. Other authors [40,41] determined that after using of a foam roller in stretching came to significant improvement in flexions of coxal joint. Other researches point that using of the foam roller has significant influence on range of motion (ROM) of hamstrings for 5 – 10 seconds with pressure of 13 kg [42]. According to study of [43] stretching with the foam roller allows muscle massage and it supports blood flow, so that its use before training can be considered as an effective way of stretching before training. Considering of mentioned above many studies coincide that using of the foam roller in stretching has benefits mainly in increasing of ROM, but also in increasing of performance. Many studies are mainly focused on adult men and women, not on sportsmen. Therefore in our research, we focused on young volleyball players to find out differences in performance and flexibility after stretching with the foam roller and dynamic stretching. We are also interested if using of the foam roller in stretching is sufficiently effective and we can use it as an alternative to dynamic stretching. In our research, we decided for these two methods of stretching, whereas according to current knowledge they are considered as one of the most effective methods of stretching before sport performance centered on speed and speed-power abilities. We wanted to know which of these methods of stretching is more effective.

MATERIALS AND METHODS

Participants

Two experimental samples (ES_{FR} and ES_{DS}) were made of young volleyball players in the year 2019/2020; ES_{FR} (n=8, age = 13.4±0.5 years, height = 173.8±7.7 cm, weight = 59.8±7.1 kg) and ES_{DS} (n=8, age = 13.4±0.5 years, height = 174.5±9.5 cm, weight = 59.4±11.0 kg). All participants in the study were instructed about the process and confirmed participation by providing informed consent. This research was approved by the Ethical Committee at the competent university. Measurements were carried out in accordance with the ethical standards of the Declaration of Helsinki and the ethical standards in sport and exercise science research [44].

Organisation of research

The research took place in the competition year 2019/2020 from 13th January 2020 to 24th February 2020. On Monday 13th January 2020 was realized incoming testing of all players where we measured their body weight and height. After that, we divided them into two experimental groups by random selection. The measurements of performance in motion tests after stretching (ES_{FR} = foam rolling; ES_{DS} = dynamic stretching) were realized from 20th January 2020 to 24th February 2020 always on Monday during 6 weeks. The level in motion tests, speed abilities, endurance in speed, explosive strength and flexibility in evaluation of results was measured for every week individually and then as average level from six measurements in ES_{FR} and ES_{DS}. Volleyball players warmed up (double-quick march) before all measurements and then they made stretching with appropriate stretching method and the same stretching sequence of muscle groups under examiner's supervision. The process of testing was explained and shown to examined players before individual measurement.

Measurement

The following tests were used in the research: The sit and reach test (SR) was used to assess low back and hamstring flexibility. The result of one measurement was the reaching of middle fingers of the hand in forward bend in centimeters which was registered on examined sit and reach box with accuracy of 0.1 cm. Higher number means bigger overhang – better flexibility.

The test – 1 kg ball throw in kneeling position (H2) was used to determine the explosive power of the dominant upper limb. The result of one measurement was the throwing distance measured in meters with accuracy of 1 cm.

The test of block jump (BS) and spike jump (SS) was utilized in order to measure the special explosive power of the lower limbs. The average height of the vertical jump in both jumps was expressed in cm with accuracy of 1 cm.

The sit-up test (SU) in lasting of 30 seconds was made to determine explosive and endurance power of abdominal muscles. The result of one measurement was the number of repetitions in sit-ups in 30 seconds.

The E-Test (ET) was used to detect special speed. The result of one measurement was the time in seconds (s) with accuracy of 0.1 s in which the examined person was able to run over the track in „E“ shape in the shortest time.

The run to cones (RC) was used to find out endurance in speed. The result of one measurement was the time in seconds (s) with accuracy of 0.1 s in which the examined person was able to run over the track in „fan“ shape in the shortest time.

The characteristics of stretching by using the foam roller:

- Foam rolling duration is 20-25 seconds.
- 5-8 seconds of rest were inserted in between the individual exercises.
- Each exercise was repeated 8-10 times.

The characteristics of stretching by using dynamic stretching:

- The intensity of the exercise follows the basic methodology of dynamic stretching i.e. 8 repetitions in 5 seconds.
- 5-8 seconds of rest were inserted in between the individual exercises.
- Each exercise was repeated 10-12 times.
- The intensity level of stretches was kept to 1–3 with slight pain.

Data analysis

For achieving of aims of the study – the effect comparison of foam rolling and dynamic stretching on performance in motion tests by young volleyball players – was used Independent Samples T Test. The sample effect size in Independent Samples T Test was evaluated by coefficient Hedges g , which was interpreted according minimal threshold values of effects: $g = 0.20$ – small effect, $g = 0.50$ – medium effect, $g = 0.80$ – large effect [45]. Mann-Whitney U Test was used in case of rejection of normality of data dividing. The sample effect size in Mann-Whitney U Test was evaluated by coefficient r [46] which was interpreted according minimal threshold values of effects: $r = 0.10$ – small effect, $r = 0.30$ – medium effect, $r = 0.50$ – large effect [45]. Normality of data dividing was checked by Shapiro-Wilk Test. The probability of type I error (alpha, α) was set to 0.05 in all statistical analyses. We used Mean (M), Standard Deviation (SD) and Median (Me) in exploration analysis of data. M and SD was used for data expression in Independent Samples T Test. Me was used in Mann-Whitney U Test and in data where was variation coefficient > 0.5 and M had not equity of redemption. IBM SPSS Statistics V. 19 (SPSS Inc., Chicago, Illinois, USA) was used to process the statistical analysis.

RESULTS

We made random selection into both experimental samples before beginning of research that lasted for 6 weeks. The results did not show statistically significant differences ($p > 0.05$) between experimental sample with the foam roller (ES_{FR}) and experimental sample with dynamic stretching (ES_{DS}) in following motion tests: the sit and reach test (SR), the test – 1 kg ball throw with dominant upper limb in kneeling position (H2), block jump (BS), spike jump (SS), sit-ups (SU) and E-test (ET). There was not a statistically significant difference ($p > 0.05$) between ES_{FR} and ES_{DS} in run to cones (RC) although effect size showed higher level with large effect ($g = 0.59$) for ES_{DS} in comparison with ES_{FR} .

Table 1. Statistical evaluation of the effect comparison of foam rolling and dynamic stretching on performance in motion tests by young volleyball players between experimental sample with foam rolling (ES_{FR}, n=8) and experimental sample with dynamic stretching (ES_{DS}, n=8).

Test	W	ES _{FR} M (SD) or Me	ES _{DS} M (SD) or Me	Statistical analysis		
				Independent Samples T Test or Mann-Whitney U Test	Effect size (ES)	
					ES value	ES level
SR	1.	1.5	2.0	$U = 28, Z = -0.42, p > 0.05$	$r = 0.11$	small
	2.	3.0	3.0	$U = 25.5, Z = -0.69, p > 0.05$	$r = 0.17$	small
	3.	3.5	1.5	$t = 0.78, p > 0.05$	$g = 0.39$	small
	4.	3.0	2.5	$t = 0.76, p > 0.05$	$g = 0.38$	small
	5.	4.5	2.5	$t = 1.02, p > 0.05$	$g = 0.38$	small
	6.	4.5	2.5	$t = 1.05, p > 0.05$	$g = 0.53$	medium
H2	1.	906.3 (192.2)	991.3 (179.5)	$t = -0.91, p > 0.05$	$g = 0.46$	medium
	2.	965.0	960.0	$U = 27.5, Z = -0.47, p > 0.05$	$r = 0.12$	small
	3.	972.5±179.4	1016.3 (158.6)	$t = -0.52, p > 0.05$	$g = 0.26$	small
	4.	980.0 (183.9)	1005.0 (188.7)	$t = -0.27, p > 0.05$	$g = 0.13$	no effect
	5.	985.0 (191.8)	1006.3 (189.1)	$t = -0.22, p > 0.05$	$g = 0.13$	no effect
	6.	987.5 (181.0)	1020.0 (166.6)	$t = -0.37, p > 0.05$	$g = 0.19$	no effect
BS	1.	267.0	258.5	$U = 27, Z = -0.53, p > 0.05$	$r = 0.13$	small
	2.	264.1 (13.1)	260.5 (12.1)	$t = 0.57, p > 0.05$	$g = 0.29$	small
	3.	264.8 (13.2)	260.9 (11.8)	$t = 0.62, p > 0.05$	$g = 0.31$	small
	4.	269.0	258.0	$U = 27, Z = -0.53, p > 0.05$	$r = 0.13$	small
	5.	270.0	259.0	$U = 26.5, Z = -0.58, p > 0.05$	$r = 0.14$	small
	6.	265.5 (13.0)	262.1 (12.7)	$t = 0.53, p > 0.05$	$g = 0.26$	small
SS	1.	274.3 (14.7)	273.3 (12.7)	$t = -0.15, p > 0.05$	$g = 0.07$	no effect
	2.	276.5 (14.9)	273.5 (13.6)	$t = 0.42, p > 0.05$	$g = 0.21$	small
	3.	277.0 (15.4)	272.9 (13.3)	$t = 0.58, p > 0.05$	$g = 0.29$	small
	4.	277.3 (15.0)	274.3 (13.9)	$t = 0.42, p > 0.05$	$g = 0.21$	small
	5.	277.6 (15.1)	274.4 (13.6)	$t = 0.45, p > 0.05$	$g = 0.21$	small
	6.	278.1 (15.1)	275.0 (13.2)	$t = 0.44, p > 0.05$	$g = 0.22$	small
SU	1.	25.5 (2.2)	25.4 (3.1)	$t = -0.09, p > 0.05$	$g = 0.05$	no effect
	2.	25.3 (1.6)	25.0 (2.6)	$t = 0.23, p > 0.05$	$g = 0.12$	no effect
	3.	26.0 (2.2)	25.4 (2.2)	$t = 0.57, p > 0.05$	$g = 0.28$	small
	4.	26.5 (2.2)	25.4 (2.3)	$t = 0.98, p > 0.05$	$g = 0.49$	small
	5.	26.0 (2.3)	25.6 (2.3)	$t = 0.32, p > 0.05$	$g = 0.49$	small
	6.	26.3 (2.2)	25.6 (2.1)	$t = 0.58, p > 0.05$	$g = 0.29$	small
ET	1.	20.9 (2.1)	20.8 (1.2)	$t = -0.19, p > 0.05$	$g = 0.10$	no effect
	2.	20.7 (2.4)	20.6 (1.5)	$t = 0.05, p > 0.05$	$g = 0.03$	no effect
	3.	20.4 (2.2)	20.8 (1.5)	$t = -0.44, p > 0.05$	$g = 0.22$	small
	4.	20.3 (2.0)	20.6 (1.6)	$t = -0.35, p > 0.05$	$g = 0.18$	no effect
	5.	20.3 (2.0)	20.3 (1.4)	$t = -0.01, p > 0.05$	$g = 0.18$	no effect
	6.	20.3 (2.0)	20.2 (1.4)	$t = 0.16, p > 0.05$	$g = 0.08$	no effect
RC	1.	69.5 (4.3)	71.0 (5.9)	$t = -0.58, p > 0.05$	$g = 0.29$	small
	2.	67.6(3.4)	70.6 (5.7)	$t = -1.28, p > 0.05$	$g = 0.64$	medium
	3.	67.0 (4.4)	70.8 (5.9)	$t = -1.45, p > 0.05$	$g = 0.73$	medium
	4.	66.9 (4.2)	71.0 (5.6)	$t = -1.67, p > 0.05$	$g = 0.83$	large
	5.	66.8 (4.1)	70.9 (5.9)	$t = -1.63, p > 0.05$	$g = 0.83$	large
	6.	66.5 (4.5)	70.8 (5.6)	$t = -1.70, p > 0.05$	$g = 0.85$	large

W = week of measurements; ES_{FR} = experimental sample with foam rolling; ES_{DS} = experimental sample with dynamic stretching; M = mean; SD = standard deviation; Me = median; g = Hedges coefficient effect size in Independent Samples T Test; r = coefficient effect size in Mann-Whitney U Test; SR = The sit and reach test (in centimeters); H2 = The test - 1 kg ball throw in kneeling position (in centimeters); BS = The block jump test (in centimeters); SS = The spike jump test (in centimeters); SU = The sit-up test (in the number of repetitions); ET = The E-Test (in seconds); RC = The run to cones (in seconds).

During 6 weeks of measuring of stretching effectiveness on level of performance in motion tests between ES_{FR} and ES_{DS} there were the highest differences in run to cones (RC). Statistical significance of difference was not shown ($p>0.05$) in any week. Although effect size was determined in two cases as middle effect and in three cases as large effect, still in behalf of ES_{FR}. There was not any statistically significant difference ($p>0.05$) in any motion tests in any week. The effect size showed in SR middle effect in one week in behalf of ES_{DS}. There was a difference in H2 test with middle effect in one week in behalf of ES_{DS}. In other parameters (BS, SS, SU and ET) were differences only with small or none effect in all six weeks. Complete results are presented in Table 1.

DISCUSSION

The main determination of this study is that we did not find out statistically significant difference ($p>0.05$) between ES_{FR} and ES_{DS} in test (RC), although effect size showed higher level with large effect for ES_{FR} in comparison with ES_{DS}. Effect size showed in two cases middle effect and in three cases large effect, still in behalf of ES_{FR}. Test (RC) is focused on determination of special endurance in volleyball, especially on short-term endurance. According to achieved results, we assume that stretching with foam rolling could be with intensive loading and in lasting of 60 seconds with dominating LA system more appropriate in comparison with dynamic stretching.

Generally we did not find out significant differences ($p>0.05$) between effectivity of stretching in ES_{FR} and ES_{DS} in any our motion tests. According to many studies which mention that muscle power is improved by sportsmen after dynamic stretching [27], sprint [28,29] and jumps [30], we regard our findings as eminent because we found out that using of foam rolling in stretching is proper effective method of stretching. We think that this method can be uses as alternative to dynamic stretching. Similar as [43] they consider stretching via foam rolling before training as effective way of stretching because it allows muscle massage and supports blood flow too. Our results regarding comparison of performance after stretching with foam rolling and dynamic stretching are in accordance with [36]. Their results of repeated measures analysis of variance yielded no pretest to posttest significant differences ($p>0.05$) among the groups for VJ (vertical jump) peak power ($p=0.45$), VJ average power ($p=0.16$), VJ peak velocity ($p=0.25$), VJ average velocity ($p=0.23$), peak knee extension torque ($p=0.63$), average knee extension torque ($p=0.11$), peak knee flexion torque ($p=0.63$) or average knee flexion torque ($p=0.22$). Although the authors realized that in hip flexibility was statistically significant difference when tested after both dynamic stretching and foam rolling ($p=0.0001$). Alike many other authors say that they did not discover statistically significant differences between stretching with foam rolling and dynamic stretching, they found out that flexibility [40,41] and ROM [35] had improved after using foam rolling. In our study we did not discover any significant difference ($p>0.05$) by young volleyball players by using foam rolling in comparison with dynamic stretching. Paradoxically in one monitored week the effect size showed middle effect in behalf of ES_{DS} in flexibility test (SR). According to our findings, we think that appropriate dynamic stretching can help to achieve the same flexibility as we achieve it after using of techniques of myofascial stretching via foam rolling. Many other authors [47,48] declare that it comes to increase of flexibility and ROM after dynamic stretching. We aware that results in test (sit-and-reach), that determines the flexibility of both low back and hamstring, could be influenced by chosen exercises in stretching with foam rolling and dynamic stretching. In the sample ES_{FR} we used one exercise for low back and in the sample ES_{DS} we used three different exercises for low back. The other interesting finding is that effect size showed middle effect in test (H2) in behalf of ES_{DS} in one week. Some more studies [49] notice that dynamic stretching is adequate effective stretching method for upper part of body and arms to achieve maximal performance in the test with the ball. According to mentioned above we can say that dynamic stretching could be more adequate method for stretching of arms, although we did not find out any statistically significant differences ($p>0.05$) in comparison with ES_{FR}.

This study has some limits. The main limit is the number of examined sportsmen who were chosen to this study because chosen sportsmen were divided into two experimental samples with 8 sportsmen. The low number of volleyball players can be a problem in connection with the use of

statistical test and statistical significance, eventually interpretation of results. It comes to a large Type II error (Beta error) with a small number of sample sizes, where statistical tests show a result with "no significance" even with relatively large - existing differences. This is necessary to take into account in further research. This may have been one of the factors that prevented us from finding statistically significant differences between stretching with foam rolling and dynamic stretching in our pilot study too. The other limit can be the fact that examined sportsmen use dynamic stretching before loading in training process normally some years (2-3 years), they had met with myofascial stretching via foam rolling for the first time only few days before testing. Therefore, we assume that this new method of stretching could be one of disturbing factors. As it turned out, in some tests (SR, H2) there was a tendency for higher efficiency of dynamic stretching compared to foam rolling. In the RC test, the results show a better foam rolling effect compared to dynamic stretching. In others, the differences were not significant even in terms of effect size coefficients. However, it is possible that longer adaptation times and working with foam rolling can bring results with even greater benefits for foam rolling. Distortion of results could happen in connection with test of flexibility (sit-and-reach), where we establish the flexibility of both low back and hamstring. In the group ES_{FR} we have used one exercise for low back and in the group ES_{DS} we have used three exercises for low back. We devise to use stretching with foam rolling in the test sit-and-reach but it should be focused more on low back. The next study should also include a straight leg raise test to examine the effect of foam rolling on hamstring muscle length more specifically. In our study, we secured the same incoming level of both experimental samples. Despite of this we recommend to change groups among each other by preparing a new study of stretching effectivity comparison between foam rolling and dynamic stretching. It means that the group, which used stretching with foam rolling, will stretch with dynamic stretching next 6 weeks. The group, which used dynamic stretching, will stretch with foam rolling. It allows evaluation that is more objective. It is appropriate to integrate a control sample as reference of fact finding in experimental research. In our study, we have not a control sample because we did not find useful to integrate it and test young sportsmen without stretching.

CONCLUSIONS

Many trainers try to make a training process more effective so that sportsmen can achieve maximal performances. If we want to maximize performance of sportsmen during the main part of training, it is necessary to prepare them the most effective and choose appropriate stretching method that respects training loading. Our aim of this pilot study was the effect comparison of foam rolling and dynamic stretching on performance in motion tests by young volleyball players and find out which stretching method is more effective. The results of the pilot study show that in this age group of volleyball players, warming up with foam rolling and dynamic stretching has a similar effect. However, in some tests (the sit and reach test and the test - 1 kg ball throw in kneeling position) there is a tendency to better effects of dynamic stretching, which may be influenced by the probands' habit of dynamic stretching. On the other side, we assume that stretching with foam rolling could be more appropriate with intensive loading and in lasting of 60 seconds with activating of LA system in comparison with dynamic stretching, because the results were better with a large effect in favour of foam rolling in the run to cones test. These results are though constricted by limits of the pilot study and it will be necessary to verify them on larger sample.

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