

# Optimization of Force Explosive Parameters Through Athletic Means Specific to Performance Volleyball (Pre-competition Period)

Amzar Elena, Macri Aurelia, Rada Larisa

**Abstract**—The main role of the explosive force (expansion) while practising volleyball is that of imposing a physical preparation pattern which is necessary during the whole competition period of a year time. In order to reach the already established goals, of great importance is the organisation of the force-velocity preparation for the entire annual period. Otherwise, an irrational use of the means which are meant to strengthen the force ability along with an erroneous division of the effort volume related to the principle of force- velocity and furthermore, an inefficient correlation of these with the volleyball preparation may influence the level of performance to tests (Macri A.C., 2005). Of all the bio motrical qualities, force and strength are the most critical ones within various sports. Such sports where the velocity and force dominate, will always bank on a solid development of these features. By understanding the mechanics and the physics involved by the force preparation and by including them in the training sessions, the competitiveness of players will also be stimulated. (Bompa T.O., 2002, quoted by Macri A.C., 2005).

**Index Terms**— Athletics, Explosive Force, Means, Optimization, Volleyball.

## I. INTRODUCTION

The term of “force- velocity” defines “the capacity which the neuromuscular system has so that it can defeat any obstacle with the biggest possible contraction speed” (Harre D., 1987) or “a dominant speed in a process of force” ( Chu D., 1983, 1984, 1989; Brant J., 1988; Ardelean T., 1999).

Another derivative of explosive force is the getaway force. Another derivative of explosive force is the getaway force. It represents the capacity of engaging the maximum number of motrical unities even from the beginning of the getaway act, releasing a highly initial force (Lundin P., 1985; Paliga V., 1990; Weineck J., 1993; quoted by Bondoc Ionescu D., 2004).

Velocity in force regimen is characterised by working with intensities between 30-65% of its possibilities; only with such loads one can improve the expansion indices specific to jumps.

The depth jump and similar exercises, by comparison with the regular exercises including squats with halters, applies the

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plyometric principle as an elastic phenomenon moreover than a reflex, after pre stretching the active muscle. The beneficial effects of shortening the stretching process with regard to accumulating and storing elastic energy for performing the best counter movement jump were present in works of a range of authors whose conclusions support the hereby study (Bosco C., 1992; Seliger S. and collaborators., 1980).

The objective of the research is to increase the explosive force (expansion) in the case of senior female volleyball players by specific athletic means during the pre-competition period.

The hypothesis of the research: assuming that by the use of certain athletic means in the pre-competition period, the maximum force parameters- measured through test on the force platform scale Quattro Jump, Kistler 9290AD type, there will result considerable optimization according to the standards of velocity preparatory objectives. Investigation methods: analysis and generalisation of data of speciality literature, measurement and testing methods, pedagogic experiment, statistically-mathematical method.

### A. Tests applied to:

In order to assess the explosive force (expansion) to senior female volleyball players, the testing method has been utilised, through the Bosco Protocol



applied to the force measurement scale Quattro Jump, Kistler 9290AD type.



**Squat jump (SJ)** – The test presumes to make a vertical jump from the half bent position, knees at 90° or completely squat, without a supplementary push in the ground, bent arms, hands on the hips. The fact that arms do not act, makes the performance decrease with approximately 10 cm; consequently the results (between 24 and 38 cm for females and between 26cm an 45 cm to males) are apparently low but justified. Thus SJ

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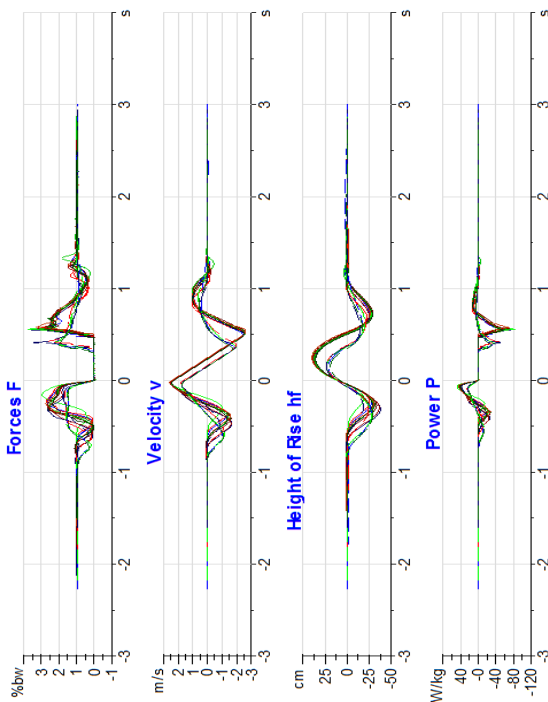
performance describes the ability to jump and the explosive force (maximal) for legs, neuro- motorial recruitment capacity and quick fibre quantity.



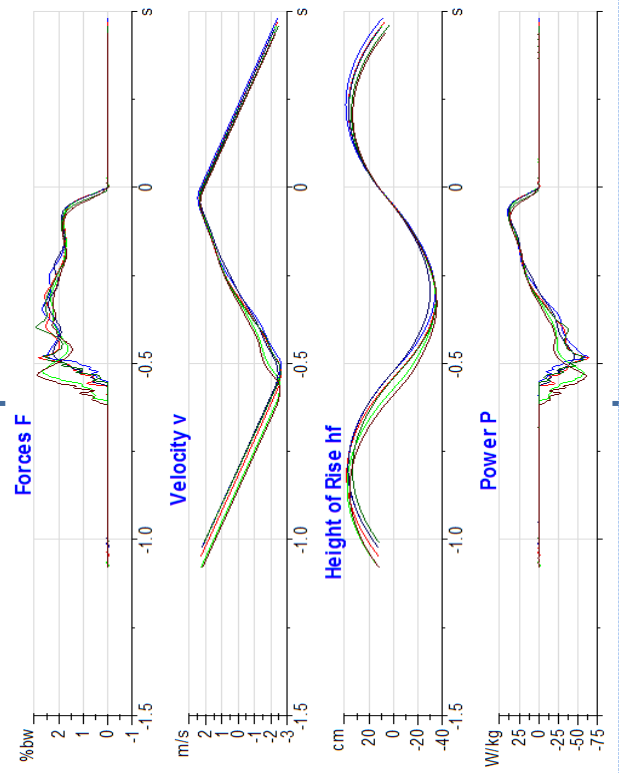
**Counter Movement Jump (CMJ)** – The test supposes to make a vertical jump, identically as in the case of testing the Squat jump, but leaving from a steady position.

Then, an energetic flexion followed by a vertical jump is carried out. Differences between the two tests are rendered in the

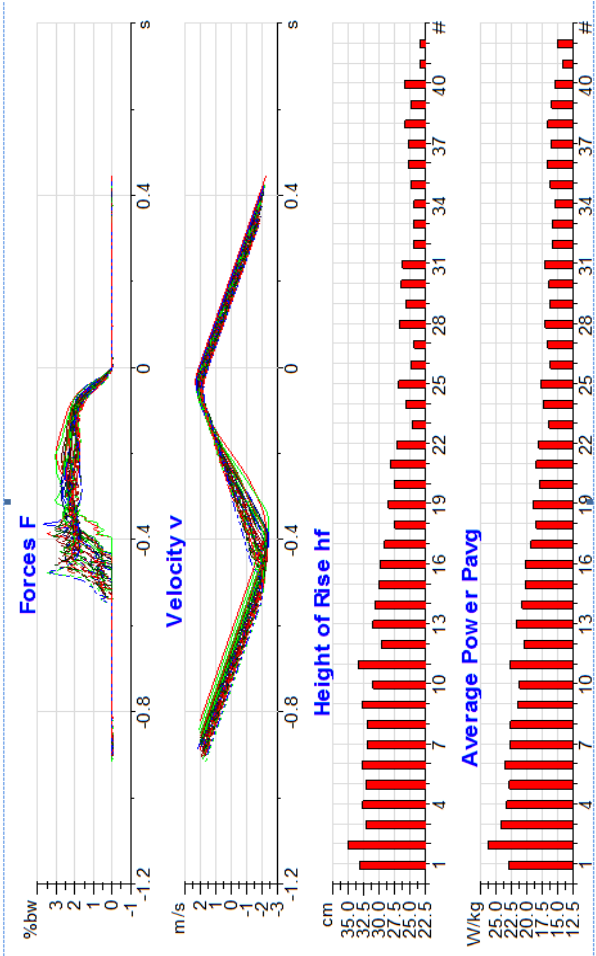
“elastic “aptitudes of sportsmen. The CMJ performance describes: assessment of explosive force VF (maximal) of legs and quality of reusing the muscular elasticity, capacity pf neuro-motorial recruitment, capacity of using the viscous-elastic force of the muscular tissue.



**Continuous Jump with Bent legs Reference (CJbref)** – Series of 5 to 7 jumps with knees bent at the floor contact phase which is used as a reference for the CJb for 15 – 60 seconds.



**Continuous Jump with Bent Legs (CJb)** – Bent knees jumps at the contact phase for 15-60 seconds. CJb performance describes: mechanical power of inferior train.

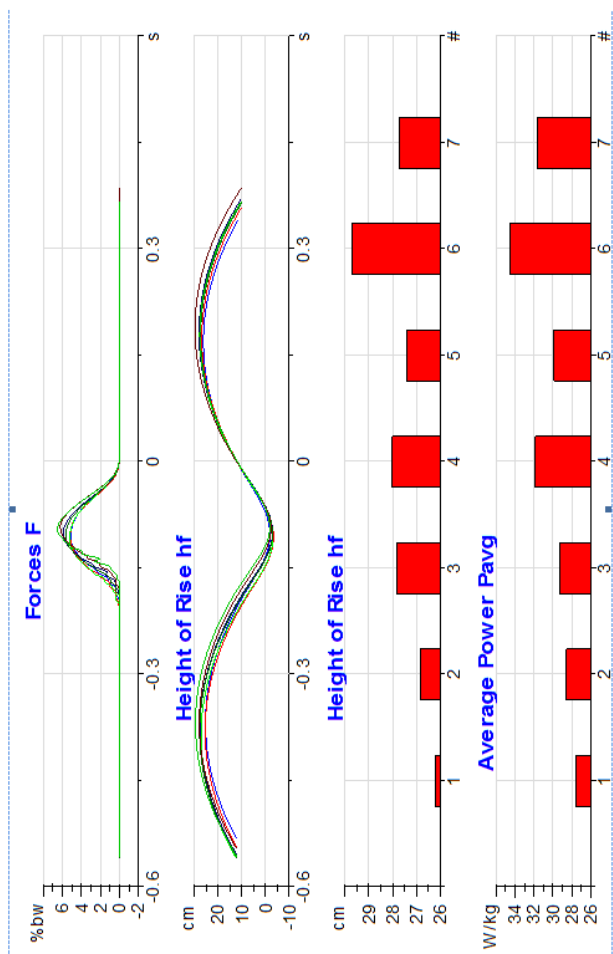




**Continuous jump with straight legs (CJs) (reactivity test)** – series of 5 to 10 maximum jumps with stretched knees (short, elastic floor contact). CJs performance describes: assessment of muscular elasticity to legs extensors, technique and tolerance at the stretched impact, quantity of quick fibres

given a few test and afterwards the hereby program was implemented.

Considering that a quick and powerful appliance of force on floor is meant to recruit the maximum number of motoric unities at the highest contraction velocity, the intended program develops such as follows: force-velocity exercises with no weight (especially plyometric exercises)- as means of increasing the muscular strength with the help of one's own body. Additionally we must add the observation that these typical athletic exercises were combined technical execution elements, specific to the preparation time and level of the female players.



Bosco Protocol may include among its components:

- Explosivity, expansion, non-plyometric (SJ) and plyometric (CMJ) testing;
- Thigh Power Tests (CJbref, CJB);
- Reactivity Tests (CJS).

## II. RESEARCH ORGANIZATION AND DEVELOPMENT

The present experiment took place in the gym of the National High School Alexandru Dima and in the gym of the Faculty of Physical Education and Sports, Pitesti including the participation of the team coach. The number of subjects in the experiment counted 12 senior female volleyball players who activate in S.C.M.. team participating in A2 Division, National Championship.

The experimental investigation took place in the period September, 1<sup>st</sup>, 2015 – October, 1<sup>st</sup>, 2015. Initially there were

Table 1: Operational model for the optimization of the explosive force to female volleyball players

Specific athletic means		
TECHNICAL DESCRIPTION	DOSING	
Long jump no élan	6X	
Long jump on the spot wit sprint	6X	
Triple jump with/ no élan	6X	
Triple jump on the spot with a leap over 3 small fences (of 60 cm length)	6X	
Penta jump with/ no élan	6X	
Specific athletic means combined with technical procedures specific to the volleyball game		
TECHNICAL DESCRIPTION	DOSING	
Successive jumps with landing on the same foot followed by 4 attack hits- two from Z <sub>4</sub> and other two from Z <sub>3</sub> , (the balls being successively launched by the coach)		
Jumps from squat to squat like 'small frogs' in series of 6to 8 repetitions, followed by 3 takeovers executed from Z <sub>1</sub> , Z <sub>6</sub> , Z <sub>5</sub> ( the takeovers are effectuated from the other comates' attack balls).		
Jumps in depth with floor separation, overpassing an obstacle (40 cm) followed by four attack hits- two from Z <sub>2</sub> and other two from Z <sub>3</sub> , (the balls being successively launched by the coach).		
Fall in depth, vertical jump with floor separation followed by three attack hits, the balls being launched by the coach himself.		
Jumps with knees bent up to chest over a row of eight fences followed by three jumps with blocking defence from Z <sub>2</sub> , Z <sub>3</sub> , Z <sub>4</sub> .		
Combinations of two jumping steps with two jumps on the more skilled foot, 3+3 repetitions, 3jumps at the blocking-executing Z <sub>2</sub> , Z <sub>3</sub> , Z <sub>4</sub> areas.		
Jumps with knees at chest on stairs + isometry + jumps with vertical floor separation		10+ 10+5
Genuflexions with vertical separation in sand		10

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Table 2: Time management of physical preparation during pre-competition period

TRAINING COMPETENCES	PRE-COMPETITION PERIOD		
	<i>Physical preparation objectives:</i>		
	<ul style="list-style-type: none"> <li>• development of repetition, reaction, execution velocity;</li> <li>• development of detent velocity (F-V);</li> <li>• development of general resistance;</li> <li>• development of general force;</li> <li>• development of articular mobility and muscular suppleness;</li> <li>• development of resistance under technical and velocity requirements;</li> <li>• development of resistance to game conditions.</li> </ul>		
	PERIOD	NUMBER OF TRAINING SESSIONS	NUMBER OF TRAINING HOURS
	September, 1-October, 1st		
General physical preparation	10%	4	8
Specific physical preparation	25%	10	20
Technical preparation	30%	12	24
Tactical preparation	30%	12	24
Psychological preparation	2,5%	1	2
Theoretical preparation	2,5%	1	2

### III. DISCUSSIONS AND RESULTS

The height of the jump (h) is one of the indicators calculated by applying tests on the platform of measuring the Quattro Jump ,Kistler type 9290AD force

Table 3: Results of the initial / final testing and dynamics of the evolution for the height indicator obtained during the 5 tests, at the experimental group

No.	Surname and Name (team)	h SJ		h CMJ		h Cjbref		h CJB	
		IT	FT	IT	FT	IT	FT	IT	FT
1.	Z.C. – false	37.8	40.9	38,5	42.8	35.2	38.7	34.,2	39.7
2.	D.I. – coordinator	37.9	40.7	36,4	40.3	35.4	39.2	28.9	34.8
3.	U.G. - coordinator	41.2	44.2	41,4	45.8	41.7	45.3	34.7	40.1
4.	I.M. – principal	37.3	39.5	38,8	41.2	35.4	39.1	28.6	34.7
5.	P.F. – principal	36.5	38.9	36,3	41.3	35.2	39.2	31.8	38,6
6.	M.A. – principal	39.1	43.1	38,2	42.6	38.2	42.1	32.5	38.7
7.	B.B. – second	41.1	44.8	42,1	46.3	38.2	41.2	32.4	39.7
8.	C.Y. – second	35.2	38.3	37,2	40.5	33.9	37.9	26.8	31.7
9.	G.E. – second	38.5	41.3	39,2	43.2	36.8	39.8	31.5	38.6
10.	P.O. – false	37.8	43.9	38,3	42.9	35.3	38.6	28.2	34.8
11.	M.E. – principal	38.1	42.8	39,1	43.7	36.2	39.1	29.3	34.9
12.	P.M. – libero	38.4	41.9	39,4	43.2	37.5	39.2	26.8	30.2

Table 4: Statistical-mathematical results at initial/ final testing and dynamics of the evolution for the height indicator obtained during the 5 tests, at the experimental group

		IT	FT	IT	FT	IT	FT	IT	FT	
1	Experimental team	X	38.24	41.69	38.74	42,81	36.58	39.95	30,47	36.37
		S	1.690	2.130	1.744	1.877	2.087	2.034	2.728	3.319
		Cv	4.41%	5.1%	4.5%	4,38%	5.77 %	6,51 %	8.95 %	9.12 %
		Progress	3.45		4.07		3.37		5.9	
		t	<b>4.398</b>		<b>5.121</b>		<b>4.005</b>		<b>4.757</b>	
		p	<b>significant &lt;0.001</b>		<b>significant &lt;0.001</b>		<b>significant &lt;0.001</b>		<b>significant &lt;0.001</b>	

Squat jump (SJ) was the first to be tested with the help of the platform. It is a probe for the explosive force (maximal) and the height coefficient registered a significant increase at the final testing by comparison to the initial one (3. 45 cm). the variability coefficient shows a great homogeneity of performances (4.41%, 5.1%) and the value of “t” was of 4,398 (significant p<0,001) for the tested group.

Another relevant test applied in our research was the counter movement jump (CMJ), which aims to assess the explosive force VF (maximal) of legs and the quality of reusing the muscular elasticity, the neuro- motorial recruitment capacity , the capacity of using the viscous elastic force of the muscular tissue.

As it may be noticed according to tables no. 1 and 2, at the final testing of this probe, the team under experiment got an initial average of 38, 74 cm while at the final testing recorded 42,81 cm. Calculating the variability coefficient we may observe a higher degree of homogeneity (4.5%; 4.38%). The values of  $\sigma^2$  were 5. 216 (significant <0.001) for the tested group.

The third probe according to the Bosco Protocol is the jump with bent legs reference (CJbref), which describes the mechanical force of inferior train.

At the initial testing the surveyed group registers 36, 58 cm. Progressively, at the final testing the respective team obtained an average of 39. 95 cm. The value of ‘t’ is of 4, 005 (significant p<0.001) and the coefficient of variability pinpoint a group with a higher homogeneity degree (5.77%; 6.51%).

In the case of the jump with bent legs (CJB), which presumes the mechanical force of the inferior train, there was the highest progress of the team during the experiment. Initially the team had 30.47 cm whereas at the final test it increased to 5.9 cm. Consequently, it is the probe with the greatest progress and ‘t’ value confirms this thing (t=4.4571) significant for p,0.001. As concerns the variability coefficient, it also recorded high homogeneity (8.95%, 9.12%).

### IV. CONCLUSIONS

The hereby research has proven the practicality of specific athletic exercises in order to build up a serious basis for force a but also for training the explosive force through hiring a bigger number of motorial unities even from the start of contraction.

The specificity of the volleyball game supposes to



accomplish a major explosive effort in a very short time, with recruitment of a higher number of motorial unities.

Obtaining performances with regard to the high jump which is absolutely necessary in the volleyball game becomes conditioned by the effects of shortening the stretch in terms of accumulation and storage of elastic energy.

As observed, the experiment had intended a certain structuring of the force preparation process which allowed reaching a high level of force, when needed, respectfully before the completion.

Developing the explosive force remains the basis of sports and various probes where dominant is the force-velocity speed. Understanding their importance in the process of physical preparation, understanding of the mechanical and physical knowledge regarding force preparation and including such principles in the training sessions will surely contribute to an increased efficiency of the game.

By applying the operational model proposed by us lead to significant improvements for all the assessed parameters, as follows:

- **Squat jump (SJ)** an explosive force probe (maximal), at the coefficient of height, the statistical-mathematical analysis shows significantly over the average of  $<0.001$ ,  $t=4.398$  and the recorded progress is 3.45 cm;
- **Counter movement jump (CMJ)**, which assesses the explosive force VF (maximal) when using legs and also the quality of reusing the muscular elasticity, the capacity of neuro-motorial recruitment, the capacity of using viscous-elastic force of the muscular tissue, at the height indicator- the analysis showed a significant change for the average of  $0<0.001$ ,  $t=5.121$  and the recorded progress is of 4.07 cm;
- **Continuous jump with bent legs reference (CJbref)**, which indicates the mechanical force of inferior train, according to the statistical-mathematical analysis shows a significant increase for the average of  $<0.001$ ,  $t=4.005$  and the recorded progress is 3.37 cm;
- **Jump with bent legs (CJB)**, which supposes the mechanical force of inferior train, according to the statistical-mathematical analysis presents a significant increase over the average of  $<0.001$ ,  $t=4.757$  and the recorded progress is of 5.9 cm.

The increase of the technical excellence of every female player, in accordance to the specificity of each position in the team, by the help of the specific athletic means, represented the most important objective since during a game, these specific motorial action should be applied, nonetheless taking into account the biometrical characteristics of the volleyball players.

Both the development of the maximal force and of the force of the inferior limbs contributed to the improvement of technical execution's level and also to the tactical behaviour of the senior volleyball players. Thus the effectiveness lays into the excellent accomplishment of the game tasks and of the performance objectives.

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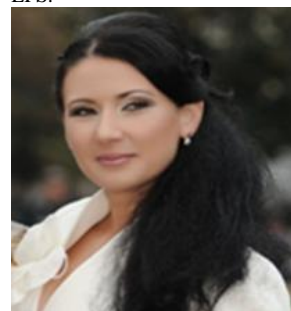


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Professor of Physical Education and Sport, Athletics coach ,Final doctoral stagium studies- -I.N.E.F.S. Chisinau 2005, A.N.E.F.S. Bucharest 1994.

**Competencies:** theory and methods of Physical Education; theory and methods for the development of motor skills; theory of sport training

(athletics).

**Scientific research:** Contracts obtained in the National Plan for Research, Development and Innovation and contracts with various companies in the country: „Educational strategies for training and social integration of children in the rehabilitation centers ”- member of the project; Strength training „ Optimizing the performance handball against training period”-



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PhD degree on course, Studies Stage- Sport and Physical Education Faculty, Pitesti University, 2009.

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Scientific Research: Over 40 articles

published in various magazines and international conferences: 14th Annual Congress of ECSS OSLO 2009, Norway 24-27 June, Scientific Conference „Physical Education and Sport in Research” and “Physical Activity and Aging, 10-12 September, 2009 in Rydzyna/Poland.

Published books - 5: A to Z volleyball, Editura Universității din Pitești, 2005, ISBN 973-690-467-9, p. 176, Niculescu Mugurel, Rada Larisa, Health through sport, Editura Universitaria Craiova, 2008, ISBN 978-606-510-030-5, p. 160, Rada Larisa, Marinescu Ancuta, Amzar Luminita, Volleyball from questions and answers, Universitaria Craiova Publishing House, 2008, ISBN 978-606-510-294-1, Niculescu Mugurel, Niculescu Ionela, Malousaris Grigoris, Rada Larisa, p. 190, Athletic performance, Universitaria Craiova Publishing House, 2009, ISBN 978-606-510-677-2, Niculescu Mugurel, Rada Larisa, p. 183,

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Member ICSSPE - International Sport, Science and Physical Education Council - 2008, 2009, 2010.

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