TRAINING

BENCH PRESS TECHNIQUE

as told to Powerlifting USA by Boris Sheiko, Vladimir Fetisov, and Boris Lukyanov

Boris Sheiko's *training theories are behind the success of the Russian PL team*

The athlete's technical skill is an integral notion of the sport training theory and methods. Technical skill takes a special place amongst the other components of athletic condition because it directly relates to an athlete's physical, tactical and theoretical—an athlete's all-around training—results. The skill, in its turn, is based on such notions, as sport technology and technical preparation. The sport technology is a system of the athlete's physical actions, directed on high sport results achievement in a chosen kind of sport [1]. The technical preparation is a specific form of the training process organization, whose purpose is to use the pedagogical facilities, allowing an athlete to reach the required level of technical skill. The formation and improvement of physical actions is a multi-sided process which is inseparable from the learning and work-out session. At present time, many specialists [1,8] consider the technical preparation as a strategic direction of modern sport training.

As a man executes meaningful actions, he is interested in a manner of the goal's achievement—how well and easily he manages to do it in given conditions. In order to reach better results more easily, a man consciously takes into account and uses the conditions, in which the motion is being realized. Besides, he learns more perfectly how to execute movements. A person, in this case an athlete, studies which way and which conditions of the actions' execution are better and how he can master them. The general aim of the motions' study consists in estimation of applied forces efficiency in order to achieve the object in view. Any study of motions is finally directed on how to help to make them better. Before proceeding to the elaboration of the best ways of actions, it is necessary to estimate the already existing ones. From this, the study's aim follows consisting in the estimation of efficiency of the motion making manners.

In order to ensure the efficient technical training of an athlete, it is necessary to have some models of efficient and economical technique of competition exercises. The sport exercise technique is considered as a system of motions, consisting of some separate subsystems, which include the hierarchical lower-level structural components of the technique system of more or less difficult sport exercises. A system of motions as an integral unit is not simply the amount of its forming parts. The system's parts are connected by correlations, adding new system characteristics, which are not the content of its parts. Each system has its structure and functional connections—these are the main regularities of the subsystems interaction. The knowledge of the exercises' technique structure and functional correlations between subsystems is an essential condition to achieve the highest technical sports skill. It is necessary to present this unit, to know its structure and ways of correlation between components in a system.

The motion of parts of the body of a man represents displacements in space and time, which are being accomplished simultaneously and consecutively in a great number of joints. The movements vary in their forms and nature; they depend on the action of a quantity of applied forces. All the motions are naturally united in integral organized actions, which are being controlled by a man by the means of his muscles. Nowadays it is generally accepted that the technique of any exercise must be individual for each athlete. However, in spite of a great number of particular differences in the technology of competition exercises execution by athletes, there are its general fundamentals. Analyzing a technique, both the basis and the details, becomes an important notion. The basis of a technique is a totality of the movements and actions, which are required for the fulfillment of a moving task by the specified way. The basis of a technique is obligatory and necessary for any athlete. The exclusive importance in mastering the rational technique is devoted to the knowledge of essential components of an athletic exercise, providing for the accomplishment of the exercise's main aims.

It is very important to elaborate the correct fundamental requirements for the rational movements' performing, which will be kept within by all high qualified athletes. This decision allows to create a model, a sample which is to be taken into account during forming an individual technique by each powerlifter. It is also important to remember that the level of an athlete's technical skill shouldn't be estimated only generally (by the efficiency and economy indicators etc.), but we should also proceed from the biomechanical structure, phase criterions and elaborate requirements for the rational individual technique of competition exercises on the base of these criterions.

The system of a modern athletic training process should aim the realization of the methodology of the athlete's technical training—which must be more efficient and be based on objective quantitative biomechanical parameters of technique elements. During the educational and training process it is very important for the external environment (in our case these are the application of the exercise set and the selection of training weights) to gain such new characteristics, which would be optimum not only for different physical factors, but also stimulating the determined biomechanical directions of the training process in the athletic and technical skill improvement.

In the sport of powerlifting, there is a shortage of information on the biomechanical parameters of the competition exercise's execution. Having analyzed the scientific and methodological literature, the authors didn't find any works describing the rational basis of powerlifting exercises' technique, so the undertaking of studies in the indicated direction is revealed as very opportune. It can give very valuable information to trainers and lifters on discovering the essential principles of technical skill and rational carrying out of the training process. The detailed knowledge of the competition movements features will considerably contribute to elaborate recommendations on methodology of technique improvement by powerlifters of different qualification.

The biomechanics is an experimental and empirical science, so it studies the movements on the base of experiments. The devices register the quantitative characteristics; for example trajectories, velocities, speed-ups and others. This allows distinguishing movements and comparing them. By examining these characteristics, they mentally dismember the motion system on its component parts defining its structure. The structure components of sport exercises technique are interconnected by functional correlations on the base of objective quantitative features of motion parameters.

The analysis of motion system mechanics reveals most often dynamic, kinematical and temporal structure of a movement. We have investigated kinematical characteristics of sport exercises. For a system in question its kinematical structure represents functional correlation regularities of motion in space and time. It becomes apparent in spatial, temporal and space-time characteristics. With reference to powerlifting exercisesm these are the trajectories, velocities and speed-ups of the barbell's centers of gravity, of particular parts of the lifter's body, and of the common center of gravity of the system "athlete–barbell".

Picture 1 *–Frames of the bench press video segment featuring Babin A., world-class athlete, weight category: 90 kg., barbell's weight: 245 kg.*

The analysis of special methodological literature is evidence of the fact that nowadays in sports practice one of the most perspective means of registration and analysis of athletes' motor actions are optical and electronic methods, which serve as the basis for the biomechanical video computing analysis. The bench press technique research consisted of filming the exercise's execution with a digital camera. Then the video segments were processed by the program Motion Trace/Weightlifting elaborated in the Ufa State Aviation Technical University specially intended for the motion analysis of weightlifters and powerlifters [2]. This program makes possible, in particular, to get the graphs of trajectories of needed points, as well as the graphs of vertical constituents of displacement, velocities and speed-ups of these points depending on time. The trajectories are reduced to the plane which is parallel to the lifter's sagittal plane regardless of the corner of video filming.

The authors have investigated more than 250 attempts of exercise performances by athletes of different levels and weight categories, analyzing the above-mentioned kinematical characteristics of the CBB's motion. The first results of the research were received, making possible to systematize the forms of the apparatus displacement trajectories in bench press exercises which are classified by typical features on several groups. [5]

We are going to follow up the essential components of the kinematical structure of exercises technique on example of bench press making by Babin A., a world-class master of sports of Russia, a member of combined team of the Ufa State Aviation Technical University.

The analysis of bench press technique was carried out on the base of the phase structure of bench press [5, 7] (table 1).

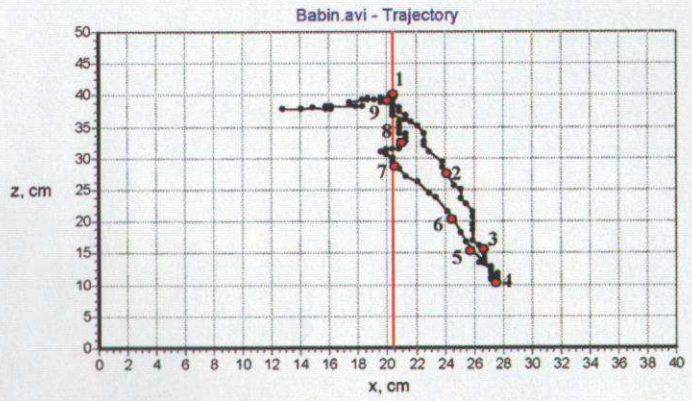
Phases of Bench Press Execution

Phase 1. Prior start position
Phase 2. Start position (fixing the weight on straight hands)
Phase 3. Descent of the weight to the chest after the referee's command «start»
Phase 4. Fixing the pause with the weight on the chest
Phase 5. Bench pressing after the referee's command «press»
Phase 6. Fixing the apparatus in the final position
Phase 7. Bar's placing to the racks after the referee's command «racks»

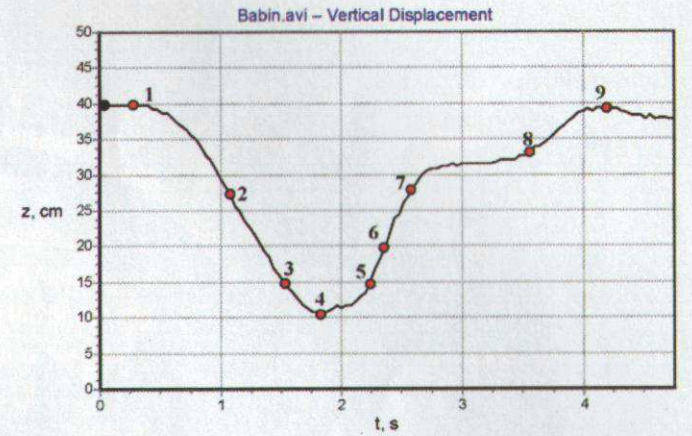
According to the technical competition rules, the 1st and the 7th phases are executed by athletes by the means of assistants [4], that's why the bench press technique analysis directly from the 3rd to 5th phases provokes the most interest.

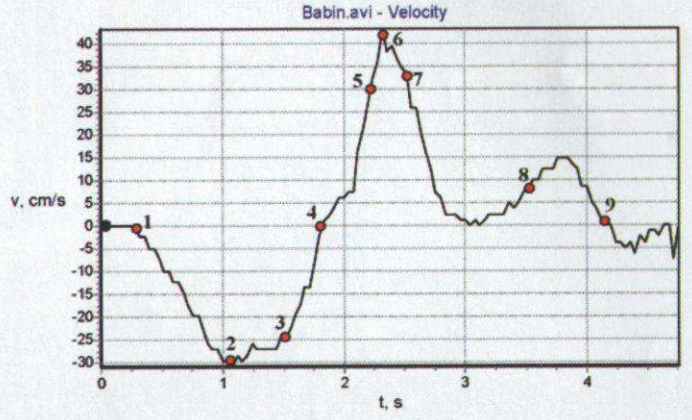
For our research we have chosen the traditional point of such kind of analysis—the centre of the barbell's butt (CBB).

In the obtained video sequence we have marked the frames (picture 1), which are convenient for the technique analysis. These frames correspond to the points, shown on time sweeps of displacement and velocity of apparatus motion (pictures 2, 3).



Picture 2 – Trajectory of bench press execution
1 – descent beginning, 2 – descent middle, 3 – bar's descent ending (5cm to the chest), 4 – bar on the chest, 5 – ascent beginning (a butt is in 5 cm from the chest), 6 – ascent middle, 7–8 – «dead point» passing, 9 – ascent ending





Picture 3 – Graphs of the bar vertical displacement and motion velocity
Velocity modules for the points: *1–0 cm/sec, 2–30 cm/sec, 3–25 cm/sec, 4–0cm/sec, 5–30cm/sec, 6–42cm/sec, 7–32cm/sec, 8–8cm/sec, 9–0cm/sec.*
1 *– descent beginning,* ***2*** *– achievement of the descent maximum velocity,* ***3*** *– deceleration of barbell's descent velocity,* ***4*** *– bar on the chest,* ***5*** *– bar's ascent in 5 cm from the chest,* ***6*** *–achievement of the ascent maximum velocity,* ***7–8*** *–velocity «failure»,* ***9*** *– ascent ending*

We are going to consider the chosen frames in greater detail:

Frame 1. The start position: gripping the bar in an overhand closed grip (thumbs around bar). According to the competition rules, the spacing of the hands may not exceed 81 cm. Using this grip width the great deal of load is on the chest muscles. Head, shoulders and buttocks should touch the bench surface. The back is slightly arched. The back and buttocks muscles are fully strained. Athlete's feet should be flat on the floor. The lifter pushes the bar to a straight elbow position fixing it a motionless position and waiting for the referee's signal «start».

(continued on page 70)

(continued from page 13)

Frame 2. The bar is on the midway of its descent to the chest. In point 2 (see the graphs of vertical displacement and velocity) the bar achieves the descent maximum speed – 30 cm/sec.
Frame 3. The bar is 5 cm from the chest (on the graphs – point 3). The descent velocity slows down to 25 cm/sec.
Frame 4. The lifter has lowered the bar on his chest. The bar's descent time – 1,25 seconds, the descent trajectory length – 32 cm. The pause duration – 0,25 seconds. (The pause is very short, it's quite difficult to make its visual estimate, but it is very well seen on the graph.)
Frame 5. After the head referee's command «press» is given, the athlete has driven off the chest with maximum exploding effort of the shoulder girdle muscles. During this moment the initial impulse goes up from feet to the head. Bar's blastoff is made up with help of deltoid muscles, triceps and lats. On the frame 5 the bar is in 5 cm from the chest, bar's speed in this point makes 30 cm/sec (see point 5).
Frame 6. The bar is on its midway to the final point and achieves its ascent maximum speed - 42 cm/sec (see point 6).
Frame 7. The maximum velocity slows down to 32 cm/sec (point 7) in the reason of athlete's inability to maintain it for a long time.
Frame 8. The bench press velocity quickly slows down to 8 cm/sec (point 8). It's the most difficult bench press part – going through the "dead point". With help of strong-willed and muscle efforts the athlete has successfully passed through this point and continues pushing upward until the straight arm position (see frames 7 and 8).
Frame 9. It's the final point of the bar's descent. Having taken the lockout position the athlete holds the bar in a motionless position until the head referee's command «rack» is given. The length of the bar's ascent trajectory is 36 cm. The increasing of the bar's ascent length relatively to its descent length is realized by the means of flections. As for the height, practically it is the same. The ascent full time made 2.1 seconds: 0.6 seconds – the initial phase, 1.0 second – dead point zone, 0.5 seconds – pressing to a lockout position.

Having carried out the exercises execution biomechanical analysis, the kinematical structure of the bench press technique is represented in the following form (See Table 1).

Phase 1. Taking of start position consists of elements:
1. Athlete's positioning on the bench. Gripping of the bar, back's flexure, feet placing.
2. Bar's taking from the racks.

Phase 2. The start position includes:
1. Bar's fixation on straight hands (points 1–1). The athlete fixes the bar in a straight elbow position.
2. The athlete's head, shoulders and buttocks are in contact with the flat bench surface.
3. Athlete's legs should straddle the bench or its blocks, and his feet should be flat on the floor.

Phase 3. Bar's descent to the chest after the referee's signal «press» consists of elements:
1. From the bar's descent beginning until the achievement of the descent maximum velocity, approximately until the middle height of descent (points 1–2).
2. From the point of the descent maximum velocity until the bar is touching the chest (points 2–4). This zone is typified by the deceleration of the bar's descent velocity.

Phase 4. Pause fixation with the bar on the chest includes:
1. Bar's fixation in the motionless position on the chest in the lowest point (point 4–4).

Phase 5. Bench pressing after the command «press» consists of elements:
1. From the upward movement until the achievement of bar's motion maximum velocity (points 4–6). After the head referee's command «press», the lifter explodes upwards and develops the maximum possible velocity of the bar's upward movement.
2. From the point of the achievement of the bar's motion maximum velocity till the dead point passing (points 6–7). The athlete's task is to keep the top speed as long as possible.
3. Going through the sticking point (points 7–8). The "dead point" passing depends on the athlete's ability to save the bar's ascent velocity, the higher the descent velocity is, the easier the dead point going through will be and inversely.
4. Bar's ascent after the "dead point" passing until the elbows are locked out, until the fixation position (points 8–9).

Phase 6. Bar's fixation in the final position includes:
1. Bar's fixation in the motionless position (point 9). After the athlete takes the straight arm position he holds the bar motionless until the referee gives the «rack» command.

Phase 7. Bar's placing on the racks. After the head referee's command «rack» is given, the athlete places the bar on the racks with the assistants' help.

Having passed more than 250 graphs of the bar's vertical displacement throughout the statistical analysis, it was revealed that the descent phases' duration was fluctuating from 0.6 to 3.0 seconds, 1,28 seconds, the pause duration fluctuations are from 0.3 to 1.8, 0.70 seconds, the bar ascent time varied from 0.5 to 5.0 seconds, in average that is 1.40 seconds. (See Table 2)

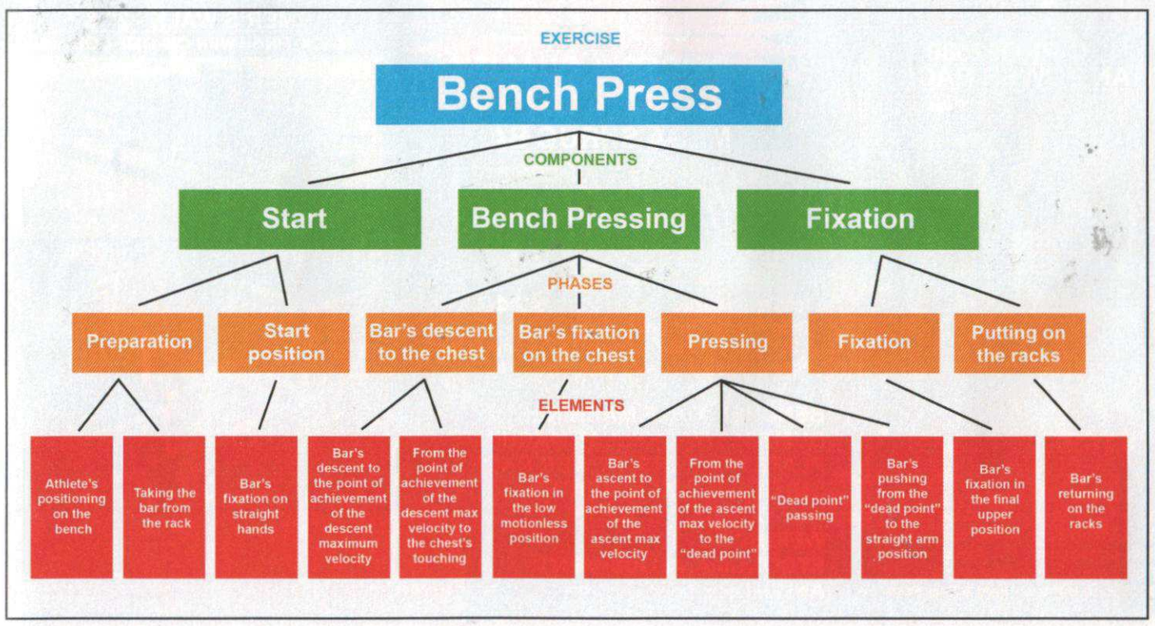


Table 1 *– the Kinematical Structure of the bench press technique is represented in the chart above (photos & tables courtesy of Sheiko)*

Table 2)

Table 2. Statistical Analysis Results for the Phases Duration During the Bench Press Exercising

	t_1	t_2	t_3	t_{sum}
Average	1.28	0.70	1.40	3.38
Mean-square Deviation	0.50	0.26	0.68	0.98
Maximum Value	3.0	1.8	5.0	8.5
Minimum Value	0.6	0.3	0.5	1.5

t_1 – time of the bar's descent on the chest;
t_2 – pause time
t_3 – time of bar ascent from the chest till the final point
t_{sum} – the full duration of a bench press exercise

The statistical analysis has also revealed the fact that the biggest number of successful attempts was made by lifters whose bench press executing duration was lower or a bit higher than the average level. Thus, we can make the following conclusions on the base of our research results:
1. The fundamental of the bench press technique is made up by 3 parts, 7 phases and 12 elements (see the table 1).
2. The falling out or disturbance at least of one element or correlation in the given complex makes it impossible to fulfill the motion task. The phases have their own determined time characteristics; their duration depends on athlete's qualification, his height and the bar's weight. The technique elements can be various beside different lifters and in most cases depend on their individual anatomical and functional particularities. The correct using of individual particularities defines the individual technique, which is the most perfect for the given athlete (upon condition of following the general rules of the rational technique). [3]
3. The velocity of the «bench press» competition exercise doing is a fundamental factor.
4. The lower the bar's ascent velocity is, more quickly (faster) the dead point zone arrives.
5. The lower the dead point zone is, the more difficulties the athlete faces while going through it.

Proceeding from the aforesaid, for lifters undergoing hardship in 10–15 cm from the chest during bench pressing, the authors recommend including in their training plans the bench press at the maximum speed with weights making 40, 50 and 55 percent from the their top lift. This will develop the speed and explosive motions capacity.

For the athletes who have some problems in the second half of bar's ascent, we recommend to include following exercises in their training plans:
a) bench press with chains;
b) bench press with rubber bands;
c) bench press from the boards of different height.

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