Biomechanics And Sport – An Introductory Viewpoint

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Abstract

Hyperplasia magazine is dedicated to taking an athlete past their preconceived genetic limitations. In order to accomplish such a feet, one must not only be hardcore in body, but also in mind and spirit. Thus, it is our goal for each reader to more perfectly understand the architecture of the human body. One should have the ability to view themselves from a diagrammatical standpoint, that is, one which encompasses the concepts of time, space, torque and velocity.

Biomechanics Defined

Biomechanics can be defined as such – The application of the laws and knowledge of mechanics to the anatomical (structural) and physiological (functional) aspects of a living, breathing system. Which in our case is the human body.

Anatomical and Physiological Analysis

If mechanics are to be applied to structural and functional aspects of the body, then it stands to reason that the primary aspect of this discipline is to grasp these characteristics. We begin by reviewing four primary subjects of anatomical study.

(**A**) Osteology – This is the discipline concerned with the skeletal system. In 1892, a scientist by the name of Dr. Wolff(2) stated one of the most vital concepts in Osteology. We have come to know it as Wolff's law.

Wolff's Law Broken Into Two Segments

1. The shape of a bone, determines(in some way) its function – Lets analyze this. There are a group of bones in our body, classified as long bones. These include your upper arm bone, or humerus and others similar in shape. If we view ourselves from a mechanical standpoint, then we can realize that such shapes were " designed " to act as levers. Such a concept, can be applied to all exercises, from the biceps curl, to the squat.

2. The second aspect of Wolfs law states conversely that actions can alter a bones actual shape. I have always found this the most fascinating sect of this particular law. You literally have the power, to alter the shape and size of a bone. By that I mean that you can increase its density
(add new bone), and also make a marked difference on each of the landmarks found within these structures.

(**B**) Arthrology – Arthrology is the study of articulations(joints). This term refers to the joining together of two bones. When studying this subject, you must realize that there are several classifications, and each is based on a number of factors, which effect movement.

A hinge joint will have less movement then a ball and socket joint. You should also realize that a joint, which is more mobile, is also more prone to injury. Such a field of study has endless implications on the mechanics of all athletics. The flexibility and strength of muscles that work through a joint, can and do effect other joints. Your body is an integrated system! It is for this reason that I intend on analyzing each joint in the human body. Moreover, it is my intension to then relate these to concepts such as locomotion. Take the lower extremity for example. Several articulations must work together to perform a squat, a sprint or a jump.

Note: Did you know that connective tissue contains numerous mechanical factors which effect strength, speed and of course flexibility. Of course you did. We intend on unlocking these in future issues. Stick around!

(**C**) Myology – The discipline which deals with the muscular system. Numerous mechanical factors influence muscular contraction. I will illustrate one of the most basic via the force velocity principle. It states that the shortening velocity of a muscle increases as force developed by the muscle decreases. In English, that means that a muscle can shorten faster with less resistance. Though such a concept may seem obvious, it has been applied to workout strategies proven to increase speed and explosion in immeasurable ways. Through proper application, the force velocity principle can enhance one's ability to train at faster speeds, in turn heightening their ability to perform at a faster and more explosive pace. This, among many other mechanical factors can take a good athlete and make them a great athlete.

(**D**) Neurology – Take a look at the back of your computer. For many of you, there are about 100 connections. You'd think you were a master electrician. However, lets think outside of what man can accomplish for a minute. The Central Nervous system is an architectural wonder. It surpasses any idea, thought, or presupposition that mankind has ever invented. Dr John Stevens stated that " it would take 'a minimum of a hundred years of Cray [supercomputer] time to simulate what takes

place in your eye many times each second(1)." How can such a vast amount information to be processed? The answer ladies and gentlemen is that the CNS has over 100 trillion (100, 000, 000, 000, 000!) synapses! How would you like to do the wiring on that? It is incredibly efficient. Each articulation in the body contains what are called "pressure receptors." These react to aspects such as postural change, or shifts in bodyweight. Pressure receptors respond to as little as two degrees of motion in a joint, making correct posture an indispensable ally.

What are Mechanics?

Websters defines it as a branch of physical science that deals with energy and forces and their effect on bodies. There are two main departments to consider.

(**1**) Statics are concerned with systems devoid of movement. Take hyerplasia magazine writer Seksi for example. Aside from the sport of bodybuilding, he is also a track athlete. The analysis(posture/alignment) of his starting position before he takes off in a race would take place in the realm of Static mechanics. In order apply statics to athletic balance., you might ask a competitor to stand on one foot, and observe how well they can manage. Other examples include one's starting position on the deadlift, the fighting stance of a martial artist, or the grip that you use during a barbell curl. Each of these has a significant role on how the body will react, when called into action.

(**2**) Dynamics is the study of systems in motion. Once again we divide this into two subsections.

(A) Kinematics analyzes the effects of time and space on movement. In bodybuilding, it has been postulated that 30 to 70 seconds is optimal for muscular hypertrophy. Choosing a weight that causes the muscles to fail within this amount of time is what this discipline is all about. Old School applied kinematics to his program on the pectorals. He knew that after three sets of bench press, that the muscles supporting the pecs would be fatigued, thus affecting the athletes ability to maximally perform a second compound movement. His goal was to annihilate the pecs however, which meant that he did not want to allow them to recover. To solve the problem he used a system of compound, followed by isolation, finished off with compound movements. The use of time was effective in that he relentlessly blasted the pecs, and allowed the supporting muscle groups an optimal environment to assist in the process. Space must also be considered. A track athlete who runs the 100 yard dash will not strategize as the mile athlete would.

This is where the term Biomechanical Effectiveness comes into play. One must select which movements that are best suited to his or her activity. A person can walk a distance of ten yards and expend less energy then a person who sprints the same distance. The first person was actually more energy efficient then the second. However, it would not be " effective " to walk that distance in the NFL football combine! Seksi, will expend more energy per step in a 100 meter race, then a mile runner would. This is because it is more effective for the mile runner to pace themselves for optimal energy expenditure for their race. They must expend as much energy as is possible in the given amount of space provided.

(B) Dynamics can be further broken down into the field of kinetics. This deals directly with the effects of forces upon the motions of material bodies. While performing the bench press, the force which your contracting muscles exert against a barbell is defined as tension, where as the force which is exerted against the muscle, by the barbell is called the load. As I stated above it is this relationship, which must be calculated when considering force velocity. Conversely, a greater force produced by the load can and will stimulate a numerous amount of motor units to oppose that load.

Studying Biomechanical Movements

There are two ways to assess mechanical efficiency. The first is based on mathematics. I.E. Athlete A's vertical leap is X number of inches, where as athlete B's vertical leap is Y amount of inches. Thus, you have calculated their efficiency based on pure numbers.
When applied to bodybuilding, you can question your strength on a certain lift. If it has remained stagnant for some time, you will want to approach that lift so as to increase your ability in the area. This is a non subjective approach and is known as " quantitive " assessment.

The second method in the study of mechanics is much more subjective. For example, you might have someone film you during a posing routine on stage. Or, during a certain exercise such as the squat. By viewing your squat you can pick out mechanical errors in your approach and fix them. Such an approach calls for a trained eye, and a sufficient knowledge base in posture and alignment. Such an approach is deemed a
" qualitive " assessment.

Final Thoughts

This article's intent was to show the importance of biomechanics, as it will be a frequent theme in our monthly magazine. We want each athlete on this site to have the best tools available to accelerate in their particular sport. Aside from the above factors listed, future installments in this area will include discussion on torque, force, power, rotation, leverage, flexibility, balance, drag, and much much more! And it will do so in classic Hyperplasia style, that is, detailed and extremely effective!

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References

1. Byte (On Capability of Eye Function Vs. Cray [supercomputer]

2. Wolff, J Gesetz der Transformation der Knochen. Berlin: Aug 1892