An excerpt from the upcoming book *Z3*

The Science and Basis of Proper Muscle Loading During Exercise

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Introduction

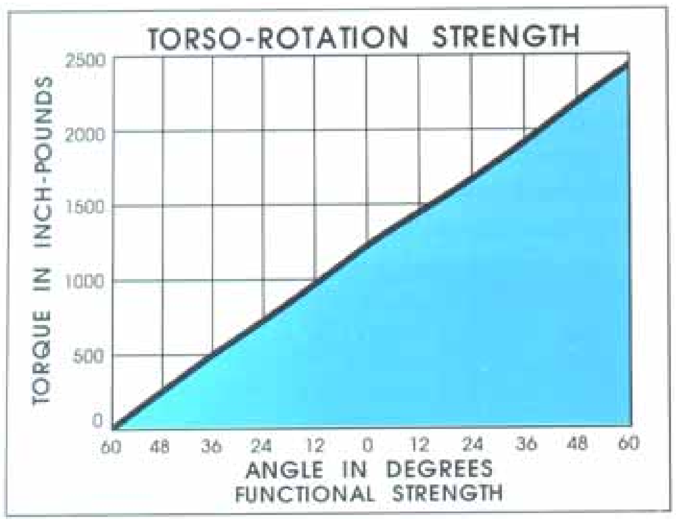
The load placed on a trained muscle or muscles refers to the weight used, such as a 100-pound barbell. The resistance experienced by the muscle will vary relative to this load, since some aspects of a movement may feel easier (lesser resistance) or harder (greater resistance). And so, what we have is a force curve of a varying resistance imposed by a load that challenges the strength curve of a muscle. In some instances, the load may feel too light, but an ideal load in order to work past 'sticking points' of an exercise. For example, with a barbell curl the load must be kept light enough to work past the mid-point, with forearms straight out, where it is most challenging. With a barbell bench press, it is the bottom third or half of the movement that is most challenging, and the weight must be kept light enough to work through that zone, although it may feel too light for the remaining half. Various equipment technology have been developed over the years to help 'flatten' the force curve so that an exercise feels more consistent throughout, with the muscles loaded more evenly throughout a range of movement.

When muscles produce force, there is a value known as ***functional strength***, such as the ability to lift a heavy box off the ground. Functional strength includes anything that contributes to force output. For example, performing a stiff-legged deadlift involves more than the contractile force produced by the muscles. When standing upright and hanging onto a barbell, there is little load felt or experienced by the lumbar, gluteal, and hamstring muscles – and only enough force is produced to maintain an upright posture. As the torso pivots forward on the axis of the hips, those muscles not only experience the load of the barbell and its altering resistance (because of lever length), but the weight of the torso, head, and arms. And the more a person bends forward, because of gravity and lever positioning, the heavier the strain experienced by the muscles. But consider if a person were to lean back, as to extend the spine past an upright position: the load decreases because the weight of the torso and head act counter to the barbell. Again, this is because of lever positioning and gravity.

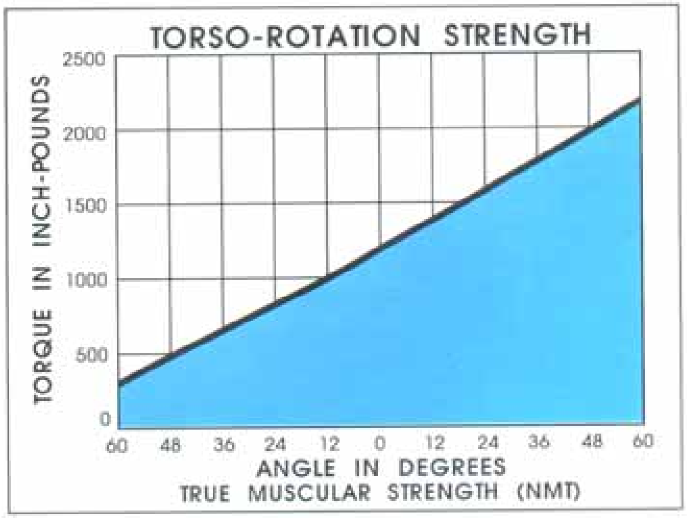
With further consideration of the stiff-legged deadlift exercise, as a person bends forward, the hamstrings and gluteals stretch, and this produces stored energy that contributes to muscular torque. The same is experienced in a bench press, whereby the compression of the back muscles and the stretching of the chest muscles add to function, which allows one to lift more weight (by conserving energy through a spring-like mechanism[1]). Similarly, powerlifters use belts, wraps, and special suits to increase stored, elastic energy throughout the body, to lift more weight.

The concept of stored energy is not new to the study of human physiology, as research in runners and the spring-like effect about the ankle have been studied for decades. When it comes to weight training, however, it seems to be ignored for the most part – at least in regard to its overall implications in the ability to lift progressively heavier loads (and at different activation amplitudes and cadences[2]) and how the layperson understands the concept. Later the issue of stored energy will be talked about in greater detail, and it must be understood that the more weight you load on the body, no matter the exercise, the more compression and stored energy effect that will occur – energy that transfers to other body parts that contribute to the moving of heavier weights. To provide an example of the effect of stored energy, the following is an expert from Arthur Jones' book *The Lumbar Spine, the Cervical Spine and the Knee: Testing and Rehabilitation* (p. 66), with testing that was conducted on a rotary torso testing machine:

"During a strength-test procedure, the subject should rotate to either end of the range of movement and the machine should be locked in that position. With the subject totally relaxed in that position the monitor will show, and the computer will record, the torque produced by stored energy; nonmuscular torque that must be measured and subtracted from the following level of tested torque in order to determine true strength in that position, Net Muscular Torque. While the level of stored-energy torque in this movement is far less than such torque produced during tests of lumbar extension, it still remains an important factor for meaningful test results.



"In his strongest position (top graph), this subject produced 2,424 inch-pounds of functional torque; in his weakest position, torque was only one inch-pound. Strength in intermediate positions varied throughout the movement range, and the strength curve was nearly a straight line, as it should be.



"In his strongest position, this subject's true strength was overstated by only 27 foot-pounds (324 inch-pounds) of stored-energy torque, and in the weakest position, true strength was understated by 25 foot-pounds (300 inch-pounds) of stored-energy torque; which is relatively low compared to the level produced in a test of lumbar-extension strength, where it may exceed 300 foot-pounds. But even with this relatively low level of nonmuscular torque, the test results were biased to an enormous degree; with one error exceeding 240,000 percent and another effort of 30,000 percent.

"Corrected for the effort from stored-energy torque, the curve of true strength (second graph) was lower in the strongest position and higher in the weakest position. Peak torque was reduced from 202 foot-pounds to 175 foot-pounds, a relatively small change; but strength in the weakest position was increased from a tested level of only one inch-pound to a true level of 301 inch-pounds, an increase of 30,000 percent.

"While an even greater degree of error was corrected in the tested ratio of strength. In the test of functional strength the highest level was 2,424 times as high as the lowest level; an increase in strength of 242,300 percent from his weakest position to his strongest position. A change in functional strength that exceeded 2,000 percent per degree of movement, on the average, throughout the tested range of 120 degrees.

"But when this tested strength was corrected for the error from stored-energy torque, the true ratio proved to be seven to one; an increase in strength from lowest to highest of only 600 percent. So the actual increase in strength, per degree of movement, was only 5 percent, rather than the indicated 2,000 percent. But even with a true change in strength of 5 percent per degree of movement, the importance of correlating measurements should be apparent; an error in position of only two degrees might produce an error in tested torque of ten percent, or more."

There is no need to read between the lines. It is evident, even upon brief review of the above excerpt that how the body is positioned and the compression and stretching of tissues can alter total body force output. But this does not mean that the target muscles are generating more force or are experiencing greater overload as weight in an exercise is increased, as will be discussed shortly.

Now, to measure ***net muscular force***, we need to subtract any non-muscular factors, such as the influence of gravity, stored energy, momentum, etc., as Arthur Jones suggests. This is an important consideration since the inclusion of those non-muscular factors that serve to improve one's ability to lift more weight is no different than using special belts, wraps, and suits in powerlifting. In other words, how much force a muscle produces and the overall strain experienced is different when we consider contractile tissue force on its own as opposed to 'by any means possible.'

However, the issue of separating net muscular force from functional strength for purposes of testing muscle ability is beyond the scope of this chapter, but was brought up for a good reason: if we do not account for how the body uses its resources, whether mental or physical, to lift progressively more weight, there could be premature load progression that does not contribute to one's physical progression and results. What is happening in the targeted muscles, and the influence of what is happening in outlying muscles cannot be ignored.

Understand that metabolic economy, in regard to how hard muscles work, how they work, and the degree in which they participate relative to a task, is based largely on how stable the organism is[3,4,5]. The more stable we are, the more efficient we work, and the more load we can lift. The harder we squeeze outlying muscles, the more we can lift, such as squeezing down on the abdominals during a leg extension exercise (which action increases production, transfer and control of force to the working limbs while minimizing joint loads[6], i.e., proximal stability for distal mobility). Because of these issues, using more load does not mean always that the target muscles are working against more load, but that the muscles responsible for increased stabilization and energy transfer allows for the use of heavier loads because of their participation and overall bodily force output. Hence, the use of more weight is not always better, whereas a proper selection of load and application of overload is relative to the environment in which 'more' weight is used or needed.

To that end, a 2006 research study[7] concluded that load is only part of the equation, whereas muscular fatigue appears to be as important if not more so. And even high-tension, muscle cramping/pumping/congestion has been linked to muscle hypertrophy, something bodybuilders over the decades knew all along. One of the researchers of this study, Dr. Toigo, further stated in an e-mail to Richard Winett[8] that "*in resistance exercise it is not the goal to demonstrate strength but to specifically deliver tension to the target muscle. The more targeted the delivery is, the less resistance can be used.*" Keep this in mind when reading the remainder of this chapter since the issue of proper load selection is of vital importance, and it is not so simple as to say "lift more weight in order to build more muscle." In fact, it can be concluded from this study that many other aspects need to be and can be focused upon with less concern in using heavy loads (as some bodybuilders who used light loads will attest, including Mr. Olympia competitors Serge Nubret and Vince Taylor).

Human Movement

In order to understand how too much load can reduce exercise effectiveness, it is necessary to detail how the body integrates as a whole when exercising, to make movement easier – particularly as load demands increase. In fact, another 2006 research study[9] concluded that <u>classical strength training studies using high loads have shown that improvements in rate of force development are mainly due to adaptations in the intramuscular coordination</u>! Moreover, there is evidence that the capacity of muscles for producing force has a strong influence on the stability of coordination in unrelated tasks[10,11], i.e., physiological adaptations that cause relatively long-lasting changes in the ability of muscles (through strength training) to produce force can influence the stability of coordination in a systematic and general manner. What this means is that with improvements in muscle strength, there are changes in muscle recruitment pattern consistency that affect functional adaptations of the neuroanatomical constraints that underlie the control of voluntary movement. In sum, strength training improves muscular coordination inside and outside the gym.

A key concept of human movement is metabolic economy, in that the body will strive to integrate its neuromuscular system as best as possible in order utilize as little energy as possible[12], and this coordinated effort magnifies the harder a person exercises and as the load increases toward a 1RM. (Moreover, an untrained muscle is more economical than a hypertrophied muscle, in that the smaller muscle, as a result of disuse atrophy, allows for a more efficient diffusion of oxygen and energy substrates because of its smaller size.[13]) This synchronization also amplifies the more frequently we repeat tasks, such as performing the same exercises every workout; thus, there is benefit toward regular change/variety, even modestly by way of making slight alterations in exercise execution, such as hand or foot placement.

In regard to the last point, in the early stages of weight training, or when introducing a new exercise (or the same exercise performed in a different manner), meeting the demands of the task (to lift a weight in a certain manner with specific muscles) outweighs other considerations, and energy expenditure remains high. But as one becomes proficient/efficient[14] or *skilled* at exercise, the body learns to coordinate its resources (breathing and heart rate, use of muscular and reactive forces, maintaining balance) to conserve energy and to make movement more fluid. As a consequence, there a direct correlation between exercise demands and metabolic processes[15,16] all as a result on becoming sensitive to, and meeting the relevant criteria of a particular muscular action[17].

The term ‘proficiency’ likely was used first in 1992, in a paper by Caldwell and Forrester[18]. They viewed the concept as a means to describe task goals, used to measure variables that reflected one’s ability to attain those task goals, such as the coordinated action of muscle force production, limb segmental motions, successful movement patterns, energy transfer and transformation mechanisms, etc. In essence, it is the coordinated and adapted whole of the body that enables one to use progressively heavier loads without a concomitant increase in muscle hypertrophy or even muscle strength (by means of objective measurement beyond lifting proficiency)[19], i.e., a large part of the improvement in the ability to lift weights is due to an increased ability to coordinate other muscle groups involved in the movement such as those used to stabilize the body. The body works so well in establishing neuro-patterns that you could train one limb and the other limb will receive a cross-transfer or ‘cross-education’ training effect, and you can retain strength gains even after dissipation of physiological effects (thus suggesting a strong ‘practice effect’)[20]. This should not come as a surprise, since as far back as three decades ago <u>it was a common finding in a majority of strength training studies that the greatest changes accompanying strength training can be seen in the training exercise itself, rather than in any objective assessment of muscle strength or size</u>[21]. In other words, progression in the loads lifted (viz., one’s lifting skill proficiency) in regularly practiced exercises far surpassed any development of muscle strength and mass.

Nonetheless, most trainees equate any improvements in loads lifted as a programmed signal that their muscles are stronger (that the contractile elements are able to produce more force), rather than realizing the neuromuscular coordinated effects taking place throughout the body as a whole, and within the trained muscles specifically. They then make a second error in thinking that improvements in loads lifted automatically or eventually will translate into more muscle. Doing so is both misleading and erroneous since it is possible:

1. To increase strength with very little or no hypertrophy[22,23,24,25,26,27,28];

2. To increase hypertrophy with little or no change in muscle force output[29], and unless it is the same practiced exercise (viz., force output does not improve in unlike movements that were responsible for hypertrophy);

3. For hypertrophy to optimize relative to the simplicity of the exercise (viz., more complex movements initially will involve greater improvement in skill development before hypertrophy occurs[30]); or

4. To increase hypertrophy but no where near in proportion to neural adaptations[31].

Moreover, the goal to optimize strength as opposed to hypertrophy has different training schemes involved (e.g., greater lactate levels influence hypertrophy changes[32])[33,34] and with particular changes that occur apart from an increase in muscle fiber size[35] (i.e., sarcoplasmic reticulum, cytoplasm, and lipid components increase proportionately with contractile protein), all of which may not contribute to muscle force output. One study even found that metabolic cost (muscle inroad and fatigue), and not high forces alone, are involved in the stimuli for muscle hypertrophy and strength gains following high-resistance training[36], i.e., the magnitude of load is only one part of the equation. A second 2006 study confirmed this position by indicating that using a moderate load and reaching muscular fatigue appears to have a similar stimulus for protein synthesis as performing the same exercise with a very heavy resistance.[37]

Those last three paragraphs contain a lot of vital information, as it relates to distinctive training effects and the differences in trying to become strong as opposed to trying to become muscularly large – of believing that progressive overload (no matter the overall scheme, strategy or method employed) is the key to physical optimization. Consequently, read them over a second time and it should be apparent that simply lifting heavy weights with the goal objective to be as strong as possible in chosen exercises is no guarantee that you will stimulate or optimize muscular hypertrophy. There is sufficient research and practical experience among trainees (if they are critical enough to activate their minds and analyze their training patterns) to support as much. However, if you are not convinced, then read on.

The Body as a System

Although bodybuilders should try to isolate trained muscles as much as possible, complete isolation is unattainable. The reason being, biological entities are systems (a system is a body or group of bodies or objects whose motion is to be examined[38]) open to a flow of energy, and that has many *degrees of freedom*[39] (the number of components of a control system and the possible ways each can perform). Shifting and adjusting during a barbell squat, to leverage more weight, makes this obvious as the body works to overcome internal and external resistance and to change the mechanical energy output of body segments[40]. Hence, when studying a system, such as what happens with the body during an exercise, we look at the segments involved, but also the forces in and around those segments, viz., the *frame of reference* within which the movement is studied.

Just like a coiled spring, as movement occurs so, too, does the transfer or transformation of energy throughout the system[41]. When a body part is free of support, such as lifting the arm out to the side, each segment has an effect on the other. When supported, those parts involved in movement and stabilization will change shape against the support and against each other, thus producing a 'reaction force' against and within the system. In biomechanics, there is a concept known as ***resistive force***, which force opposes or resists the movement of a system within a frame of reference and will act to increase stability[42]. These sources of stabilization include:

1. Muscle tension in the muscles acting to resist movement of a segment;
2. Resistance of connective tissues to being stretched (extrinsically, this would include elasticized wraps and special suits worn during powerlifting meets);
3. The contact of body segments, such as the biceps squishing against the forearms in the bottom position of a bench press; and
4. Fluid viscosity within the tissues and joint capsules.

And so, when you perform an exercise like the barbell squat, it is not just the quadriceps and gluteals producing force to create movement, but an integration of the body as a whole bracing, squeezing, squishing together, and stretching that transmit forces throughout the system by what is known as *internal power*[43,44], used to assist in the lifting of a weight. The more resistive force, regardless of its source, the more weight you can lift, and the more you brace, stabilize, and contract outlying muscles, the more load that can be lifted relative to the exercise's frame of reference. Stability will increase exercise efficiency and proficiency[45] because of the accumulated participation of the body. This occurs partly through muscles that are *fixators* within a movement, but there also is the issue of muscle *synergists*, those that promote the same movement or reduce undesirable or unnecessary movement that might occur as the prime movers contract[46]; thus, the force output of the prime movers is directed and redirected accordingly and with greater efficiency as practice ensues and loads increase.

Next, we have ***motive forces***, which are those that cause a change in the way a body segment moves from within the body or from outside the body[47], caused by external forces such as a loaded barbell. This could include the effect of contracted muscles and the recoil of elastic connective tissue, viz., stored energy. This means not only the target or active muscles that produce movement against a force, but any supporting or stabilizing tissue, since how they stabilize and the degree in which they stabilize can have an effect on any movers within an exercise action.

The pattern formations that develop based on the above elements are known as ***synergetics***[48,49], a biomechanics term that involves aspects of *order* (as to when things initiate and integrate) and *control* (the extent to which the parts participate and their role in the overall movement pattern, including *critical fluctuations* as the body adjusts to gain greater integrity and synergy[50]). In sum, how the body coordinates involves more than just skill of motor patterns, such as the dynamics of leg movement during walking, but also the interaction of the body under different degrees of effort and strain.

As well, as we exercise and move, the parts that make up the body interact in a nonlinear way, constrained by its internal milieu[51,52]. When we execute an exercise, such as the barbell bench press, only so many possible combinations for any person feels best, in regard to coordination, stability, and how the muscles interact to lift a weight (the degree of back arch, feet width, elbow width, etc.). Which one is chosen, and particularly with the task goal of lifting the most weight for a given number of repetitions, is determined by the interaction of the nonlinear components within the body[53], as squeezing, flexing, and shifting of different muscles have a different effect on total force output. When energy moves from one body part to another, it is known as *energy transfer* (as it carries from one area to another), and when the energy moves or shifts within the same segment, it is *energy transformation*. And to improve in such a task as lifting a given load for a certain tension time/reps, the body will exploit its dynamics based on perceptual information and *feedback*[54,55] (viz., stimulation caused by an organism's activities[56]).

The implications all this has on the mind-muscle connection are far reaching, as a trainee will unknowingly vary his or her internal movement to facilitate external movement, by altering the compromise between energy expenditure and movement accuracy, i.e., to complete the task of lifting from point A to point B with the least amount of strain on any given muscle. This cannot be avoided since it is a natural consequence of evolutionary adaptation (supported by the theory of the General Adaptation Syndrome[57], which is discussed in detail later).

When you lift a weight, no matter if on a machine, cable apparatus, or free weight, and no matter if it is a single- or multi-joint movement, there always will be a weak link within the chain. On this basis, understand that the muscle mass activated to complete a certain task (e.g., a concentration curl or a squat) is a less significant control consideration than the intensity of activation of the muscles involved[58]. There may be a specific muscle or a group of muscles that are under greatest strain, but as they fatigue or are under a strain that exceeds ideal limits that surpass controlled isolation, the more intra-muscular coordination changes[59] and the more participation that can occur from outlying muscles to tense, brace, and stabilize. In this regard, specific muscle energy expenditure is the important consideration in determining global energy expenditure.

There are various feedback mechanisms and signals in the muscles that relay or provide information about muscle activation and energy expenditure, including muscle spindles and Golgi tendon organs[60,61], besides the uptake of energy for continued contractions, integration of more motor units, etc. As more muscle mass activates, as in the case of lifting very heavy loads, the greater one's heart rate, respiration, and energy expenditure will be, particularly as target muscles fatigue. Hence, there is a 'calibration' of perceived and experienced effort with the physiological responses and feedback mechanisms. Eventually, to reduce energy expenditure of the target muscles, the body will activate and coordinate more outlying muscle mass, but which action then increases energy expenditure in those muscles. Although the localized fatigue effect may not be significant in any of these outlying muscles, the totality of energy expenditure can be significant overall, which is why some people feel very fatigued when training to muscular failure and while using loads so heavy that most muscles in the body squeeze and contract excessively to assist the targeted muscle(s).

Next, there is a difference between the perceived effort of exercise, as governed by the CNS and peripheral sensations achieved through muscular tension. Moreover, when judging the weight of an object, trainees usually focus or think of the effort put into the lifting of the object rather than in the muscular tension required to lift it[62,63]. It is not surprising, then, when you ask some people to exercise by 'feel,' by way of the quality of muscular contraction that they scoff at the idea and redirect their actions toward how much is lifted. This is true particularly of the high-intensity training crowd, whereby perceived effort is married with load progression, while diminishing the value of other types of biological feedback.

(The reason why the HIT crowd is so obsessed with load progression is a societal/cultural phenomenon. The 'leaders' and 'experts' of this exercise genre have placed much emphasis on strength changes and, as a result, this is how the HIT group exercises then perceives productive exercise[64]. This is no different than seeing different manners of walking among cultures, such as Chinese and Middle Eastern women [short and humble steps] as opposed to Western women [longer strides], in that culture and expectation of how to walk take shape within an individual. In this regard, there are constraints of how a person exercises based on what he thinks exercise is or how to evaluate it, just as other trainees tend to focus more on total tonnage, achieving the most sets in the least amount of time, etc. Hence, we need to look not only at the overall achievement in a task objective, of how people exercise, but also the manner in which it was attained.[65])

Hence, even if it is obvious that the entire body struggled to perform a barbell curl, some trainees deem such an experience appropriate simply because of what is considered a value:

1) Effort is maximal, and
2) The load is heavier than last workout.

Unfortunately, far less consideration is given to the quality of tension and work performed by the target muscles (biceps) specifically. Moreover, as the process of optimization (adaptation) of one aspect of training is being achieved, such as the focus and ability to lift progressively heavier loads at any cost (including excess or superfluous stabilization and outlying muscular tension), other aspects of training can result in nonadaptive changes[66], such as lack of muscle hypertrophy. This is true since optimizing one thing can suppresses another, and that happens in any biological system.

This must be understood, since there is no clear link between how much can be lifted and how large a person's muscles become or can become. Thousands of trainees experience regular exercise improvement without any or little physical change in muscle hypertrophy. Consider a recent research project conducted by Joe Mullen, a well respected colleague of Arthur Jones (and in the strength training field in general) and a high-intensity training enthusiast. Mr. Mullen wanted to determine the link between metabolic strength and muscle endurance. He worked with six fitness professionals who previously followed the Superslow protocol of 10-10 cadence. As Mr. Mullen described on the Iron Age Forum Internet bulletin board:

"The basic protocol is as follows: Initially, each were tested for one rep maximum strength, through the full-range-of-motion, and then, using a percentage of their maximum strength level, they worked to complete muscular failure. This established their present day fitness level, on which future results would be compared.

"Two workouts a week, using only MedX equipment, no free weight were used. Because of the design of MedX equipment, the poundages used are more than standard high-tech equipment allow. One set of eight exercises to muscle failure, for a total of eight workouts within the month of August 06.

"A minimum of eight reps and up to 12 or more reps to muscle failure were used. The trainees were advised to use a comfortable, natural speed-of-movement, as long as the positive movement was slower than the negative movement. Explosive movements were not allowed. The baseline test included five exercises, in this sequence: the leg extension, the bench press, the pull down, the overhead press, and the two arm curl.

"After establishing, the baseline data in the sequence as stated, no similar sequence of exercises were repeated each workout. The exercise sequence changed each workout. They began each workout with the exercise in which they performed the least amount of reps during the previous workout. In the final retest, the initial one rep maximum was used, and the trainee, after a one-minute warm-up attempted to perform as may repetitions with the former one rep maximum weight. None of the subjects used steroids or performance enhancing drugs."

To summarize the results, most individuals increased lifting ability significantly, whereby a 1RM was done with 300 pounds in an exercise initially, but within 8 sessions were able to achieve 7-15 repetitions with the same load. In effect, strength (performance) increased by several hundred or thousands percent! Now, it has been suggested by fitness enthusiasts (not by way of scientific evidence) that two things have to occur in order to experience muscular hypertrophy:

1) A person would have to become stronger, viz., implement progressive overload methods in exercise; and

2) An advanced trainee would have to increase strength in exercise movements by at least 50-100% to see any improvement in muscular size, when size seems to have come to a halt.

In regard to the first point, for muscular size to increase one has to lift progressively heavier loads. This is true, but within a proper context, as this chapter details. Since many long-time trainees have experienced improvements in lifting ability, but without changes in muscular size or appearance, it stands to reason that mere progression in load is insufficient to stimulate hypertrophy, albeit an important *piece* of a large puzzle. This, then, brings up the second point, whereby a person has to become ‘much stronger’ in order to see changes, but how much stronger? What are those limits when a person is struggling with hundreds of pounds? In that regard, Joe Mullen’s subjects experienced tremendous changes in only 8 workouts. When asked about muscular changes, he replied:

“I did not take any muscle measurements. The idea of the test was to measure human performance and improved functional ability. I looked at it from the point of view of the average person’s reasons for exercise. Obviously, improvements in strength and muscle endurance will provide the signal for additional muscle tissue.”

With the above response in mind, certainly there must have been some visual changes with such incredible improvement made in lifting performance. When asked to clarify the issue of hypertrophy among these subjects, Mr. Mullen stated in a private e-mail:

“All but one person wore baggy clothes, so I did not even see any skin (so to speak). It is true however, that their bodies began to take on a firmer look even through their outfits. I judged physiques shows for about 20 years and can pick up body shape improvements from a block away. And so, I feel confident they were shaping up.”

In summation, the advanced trainees ‘appeared’ to be shaping up and to be looking more firm, although it is impossible to say to what extent. More importantly, the weights increased significantly (particularly for only 8 workouts), and yet the measure of muscle that may have been developed by these individuals is questionable; otherwise, the researcher and particularly the elated subjects would have reported differently and immediately.

Mr. Mullen’s results are not unique, as many research studies have demonstrated very good or significant improvement in weights lifted with little change in hypertrophy, as referenced on page 5. Powerlifters and Olympic lifters in lighter weight categories are classic examples of individuals who become progressively stronger without changes in hypertrophy. Female trainees[67], youths[68,69], and mature trainees[70,71] are other examples of groups who can increase strength significantly with very little hypertrophy change.

And then consider the results from the legendary West Point Study[72], whereby cadet football players underwent a rigorous six week, 17 workout Nautilus circuit protocol. On average, the cadets increased each exercise by 59% (measured isometrically, which is more accurate and conservative than dealing with dynamics and stored energy, momentum, etc., when comparing changes in exercise performance). However, on average the cadets lost 1.86 pounds of lean mass (as determined by the Whole Body Counter machine and skin-fold measurements).

Some of the coordinators of this research project blamed the body composition testing (since two different teams measured body comp before and after)… and that may be the case. However, both body comp testing groups were trained in their profession and methods, and it is easy for the project coordinators to think they saw physical changes as muscles take on a different shape or fullness and as body fat reduces.

In any case, let's look at a practical example of how the use of load is misunderstood. Many HIT-enthusiasts and some exercise authorities believe that warm-up is unnecessary, in that the initial repetitions of a 10-rep set, for example, provide all the required warm-up prior to the final all-out 1-2 repetitions. And so, when a person performs those 10 reps with a particular load, and if he were to attempt a second set, he would perform fewer repetitions because of the fatigue with that load. Because of the reduction in function, this signals to him that another set is pointless since fewer repetitions would be achieved, or that a lighter load would need to be used to accomplish the same number of repetitions. Therefore, why do another set, particularly with a lighter load that would call upon fewer motor units and muscle fibers.

Next, consider an exercise as complex as the squat. Nearly anyone would include at least one warm-up set of this exercise for obvious reasons of complexity, overall strain, and the need to get into a groove before maxing out for a predetermined number of reps. With that being said, if a person did attempt an all-out set without a warm-up, he may squat with 250-pounds, but with a warm-up he could squat 275-pounds for the same number of repetitions (or whatever the weight difference would happen to be, affected by mental preparation and response to exercise, such as muscle fiber type).

Now, let's look at each instance separately. In the first instance the person limits the exercise experience to whatever he can lift for a certain number of repetitions, in the belief that further activity is pointless merely because his overall force output has reduced somewhat. This makes sense if we were to ignore the issue of hormonal changes and other influences associated with 'sufficient' fatigue/set volume and muscle hypertrophy. (I don't want to go into this aspect at this point, but suffice it to say that experts of HIT, including Jones and Darden, still recommended body part specialization of several exercises and sets to optimize muscular growth!).

However, in the second instance we can see, and most of us have experienced, the fact that a sufficient warm-up will allow the use of heavier loads, although this would depend on the nature of the exercise (and possibly the overall muscle mass involved). Based on this premise, there is more to exercise performance than simply how much load can be used, but the preparatory factors involved in how the mind and body work together to use a load or optimum load. But there's even more.

The second instance clarifies the fact that a person is not suddenly stronger in regard to actual force output, but that the preparation, coordinated effort, initial practice of skill, and a host of other known and unknown factors work together to make the body more efficient to handle a heavier load from one moment to the next. Therefore, if more weight can be lifted merely through means of warming-up and mental psyching, then it stands to reason that there are many other ways the body can work to lift a heavier load without the necessity of increasing muscle mass or even strength within the targeted muscles per se. And those other 'ways' include the energy transference and coordinated synergy of the body as a whole, as described previously.

This should make it evident that how much is lifted is relative to any situation. And all this indicates clearly that progression in load and the acquisition of strength as a consequence *may* be a key ingredient in stimulating hypertrophy, but its abuse or improper and premature application can result otherwise. Most important, as stated, an increase in lifting proficiency is no indication of potential hypertrophy changes[73]. it is the overall strategy, method, and demands imposed on the organism that is the determining factor in the end, i.e., it is how you use the weight as opposed to how much is used, and how that weight ties into the remaining elements to cause and stimulate a potential hypertrophy response.

This fact has been demonstrated by many Zone Trainees since they have produced a hypertrophy effect with loads lighter than used under traditional means. As well, it has been demonstrated by thousands of other trainees who experience a spark of growth merely by altering or changing exercise methods, exercises, or routines (and often the more extreme, the bigger the effect, such as changing from HIT to HVT, or vice versa) and without a concurrent increase in loads. And then consider those who always try to progress the load with no change, but eventually to achieve change by experimenting with different methods of training. The evidence to support these contentions is sufficient within the scientific community, and research in human energetics in particular support and explain why this is occurring, as detailed thus far.

Moreover, to my knowledge, there is no scientific evidence to support that progression of load is the catalyst to greater hypertrophy. It may be countered that the load may not be the 'be all to end all,' but that load progression is required for such to occur. It is true that progression in load is important, and that is not the argument. Rather, realize that load progression is a single part of the puzzle in the overall demands placed on the organism, and it must be applied expertly, within its limited context, and relative to all other factors responsible for stimulating growth (including sufficient volume and frequency, intensity of effort, a cycling of demands to agitate the system, etc.). This is not a novel idea, since every factor of any program for any individual is bound by the Principles of Influence, Interaction, and Reliance, and as much as been suggested by Bird, et al in a 2005 research review[74]:

"The popularity of resistance training has grown immensely over the past 25 years, with extensive research demonstrating that not only is resistance training an effective method to improve neuromuscular function, it can also be equally effective in maintaining or improving individual health status. However, designing a resistance training programme is a complex process that incorporates several acute programme variables and key training principles. The effectiveness of a resistance training programme to achieve a specific training outcome (i.e. muscular endurance, hypertrophy, maximal strength, or power) depends on manipulation of the acute programme variables, these include: (i) muscle action; (ii) loading and volume; (iii) exercise selection and order; (iv) rest periods; (v) repetition velocity; and (vi) frequency. Ultimately, it is the acute programme variables, all of which affect the degree of the resistance training stimuli, that determine the magnitude to which the neuromuscular, neuroendocrine and musculoskeletal systems adapt to both acute and chronic resistance exercise. It is essential for those involved with the

prescription of resistance exercise (i.e. strength coaches, rehabilitation specialists, exercise physiologists) to acquire a fundamental understanding of the acute programme variables and the importance of their practical application in programme design."

Reduced Effort through Movement Accuracy and Stability

The level of agonist and antagonist activity is associated with skill, in that with less skill there is more co-contraction and stiffness with movement[75], and as a person becomes more skilled at an activity, the less overall effort required to perform a task[76,77,78,79]. For this reason, it is apropos to teach exercise on machines before implementing cable and free weight exercises (and certainly before having people balance on balls and wobble boards!). In any case, what is noticed when learning new skills is the degree of localized fatigue, of the weakest link within the chain, which then necessitates that outlying muscles take over some of the work as fatigue progresses and if continued movement/repetitions are desired.

However, the same exists eventually and on the other side of the spectrum, as we become very complacent with an exercise: we know what to expect of an exercise if performed in the same manner repeatedly. Exercising in a routine environment increases confidence and improved skill with the use of heavier loads. And as the mind shifts from the working of a targeted muscle to the lifting of those loads (which cannot be escaped since trainees live in a world based on the lifting of some measure of weight), a greater coordinated effect of the surrounding musculature ensues.

Progressively, the body learns how to lift heavier loads within its movement patterns (e.g., the exercises being repeated), and metabolic energy expenditure reduces with practice (and practice improves performance[80]), as per the *Principle of Least Effort*, viz., an adaptation to movements in order to achieve a goal of using the least amount of physical energy[81]. This occurs even as speed of movement alters[82], whether moving explosively or super slow, as the body strives to become as efficient as possible in its energy expenditure. Such adaptation occurs as an ongoing process as the body becomes more expert in a given task to achieve optimization in performance, and as subtle changes develop in lifting and how the muscles interact[83,84] over the course of months or years.

One may think that a person can become only so good at lifting a weight, and that continued 'practice' is irrelevant. But consider that most professional basketball players still miss about 25% of their free throws (a well-controlled task) despite thousands of practice attempts. As one attempts to overload the muscles progressively, the additional strain does impose a modest challenge that alters conditions and which strain spreads throughout the body, as the body learns to coordinate and rearrange itself to handle any extra load. In doing so, movement patterns becomes smoother, which allows the body to produce less force necessary to complete the same action with changes taking place in the intensity and duration of the muscular demand[85].

With well-practiced activities, the full scale of energy will not be used, and there will be a reserve capacity available to compensate for any disturbance (movement outside the intended pattern, which is why the lifting of free weights can feel more fatiguing than the use of guided machines). However, with the lifting of progressively heavier loads, that reserve capacity always remains minimal, and this effect calls upon progressively more overall body mass to participate in the coordination of any added exercise load. Hence, the efficiency of a trainee would not then be described as a situation of decreasing energy expenditure, but an instance of a more efficient use of the extra energy demanded.

To clarify the bodily reactions involved, while the body learns to be more proficient in lifting a weight in a given exercise, it undergoes a process known as *attunement*, which is most obvious in a beginner trainee as he or she wobbles about when chest pressing dumbbells; but when that movement skills takes root, and the intrinsic dynamics have changed, then there occurs *adaptation*[86,87,88] (viz., adaptation to the muscles' contractile characteristics and/or within the nervous system and the alteration of the recruitment patterns). Attunement is about control in the present, as opposed to coordination of how the body learns to react to a particular environment. It is the constant feed of information of the environment around us and the actions we take that alters the intrinsic dynamics of the motor learning maps within the body that causes attunement to merge into or become adaptation.

Both attunement and adaptation are ongoing processes, even with advanced trainees, whether picking up on new exercises or when the intrinsic dynamics further change on a microscopic, unperceivable basis. Such modifications within the neuromuscular system not only produce specific coordination patterns, but with effects that become generalized[*], which make possible new solutions to particular classes of motor problems yet to be experienced because of the constant evolving CNS[89], i.e., which includes the ability to adjust and alter muscular architecture to lift a heavier weight best.

In this regard, there is a distinction between the fine-tuning of an adapted system and changing the constraints of the system itself[90], the latter of which is done by means of creating unique challenges on the body as opposed to performing the same exercises in the same manner repeatedly. Obviously 'optimization' is an ongoing process and that we never will realize what is optimum when trying to develop our muscles. As part of this process, energy expenditure will continue to improve even after performance reaches a plateau[91], as with a powerlifter unable to lift beyond a particular 1RM, but who will expend fewer resources to do so from one workout to the next. It also suggests that as we become more skilled and proficient at lifting, optimization criteria and internal/external constraints must change. The issue of constraints is interesting since they can involve different perspectives. There are:

1) *Task constraints* (successfully completing a task, such as lifting 100 pounds 10 times);
2) *Personal constraints* (an individual's perception-action capabilities, such as what he or she deems a successful workout to be); and
3) *Optimality constraints* (least cost to the system)[92,93].

[*] In this respect, the concept of 'load' used in an exercise is a *parameter*, or a modifiable feature of a generalized motor program. A generalized motor program is a pattern of movement, rather than a specific movement, such as a 'chest press' as opposed to any particular type of chest press, e.g., MedX machine press vs. barbell bench press, etc.

And in this context, one type of constraint may be operating, but which can be overruled if other constraints take preference. For instance, consider the contradiction if a person's main goal is to become more muscular, but at the moment of exercise the focus is directed toward a task goal of lifting a certain weight a given number of times, and that the person coordinates his or her body optimally to make the exercise easiest (most proficient) in order to achieve that task goal. In this case, the overall demands placed on the targeted muscle may reduce, and the primary goal of muscle hypertrophy becomes compromised.

With an increase in movement economy, through regular practice of exercise, there is an aggregate reduction in muscle activity, a factor most prevalent in sports. But is the same true of strength training, whereby there is constant progression in the load that serves to challenge the body almost indefinitely until reaching a peak in lifting proficiency?

Bear in mind that progression in load often is attainable because of the increased ease in performance, and not because a trainee is developing more muscle, or even strength. The same general motor pattern of how to do a squat remains, but the execution of the movement can involve and evolve into a different and specific coordination pattern[94]. This is why lifting 100 pounds feels no more challenging than lifting 75 pounds a few months previous. In either instance, a person may exert maximum effort on the final repetition, but the 75 pounds felt just as heavy as 100 pounds relative to the time in which it was attempted. Now, if a person were to develop more muscle (achieve a greater cross-sectional area to produce more force), it would make sense that an additional 25 pounds could be lifted with all factors remaining equal (i.e., form and level of exertion).

However, this is not always the case, and particularly among advanced trainees who are highly skilled at what they do and who become progressively more adept at lifting heavier weights without any change in body composition. Moreover, being very consistent in how you perform exercise allows you to lift progressively heavier weights more easily, just as athletes achieve their best performances at velocities at which they attain the highest mechanical efficiency[95]. But allowing the body to adapt more easily and quickly to the exercise stimulus is the surest way to prevent hypertrophy from occurring. Rather, hypertrophy is a physiological state that must be agitated and forced, since the body does not desire developing and maintaining a metabolically more expensive state of existence. As stated, it wants to be as efficient and proficient as possible relative to the tasks imposed upon it.

If we look at the issue of energy expenditure and information processing, there is a direct link between energy cost and information processing in control of movement and how the CNS interprets and controls muscular contractions[96]. We need to know this since trying to overload a muscle too quickly with more weight will result in progressively more muscular activity (strain and tension) in non-targeted areas. And the more energy utilized in squeezing and contracting outlying muscles, the more performance quality diminishes and the more fatiguing the event.

In sports and locomotor skills, this may seem obvious, but in weight training the effect has more to do with compromising the mind-muscle connection in having the target muscles contract as hard as possible for as long as desired or intended with a given load. Consequently, the more the outside muscles work to help lift a load, the more you take away the mental connection to the muscle you were intending to train as hard as possible (the mental aspect will be discussed later). The quantity of activating superfluous muscle thus takes away the performance quality from the targeted area.

This is further evidenced in the idea that the level of muscle activation can affect proprioception[97] (and one's *kinesthetic sense,* or *kinesthesis,* or the sensory system that informs us of the position and movement of parts of the body), which then affects workout performance quality and accuracy. As effort and strain in a muscle increases during exercise, the discomfort, distress and anxiety experienced over-rides muscular tension and control as the mind shifts from movement quality to 'lift the darn weight!' This effect becomes more pronounced as progressively more muscle is used to lift a weight. And if a trainee were to load up a bar too much, too often to call upon the outlying muscles progressively more or to excess, the direction of muscle training becomes one of weight lifting.

More on Movement Proficiency

All land animals, including humans, have a particular characteristic: larger areas of muscle are closer to the body's center of mass, with smaller muscles located more distal. One reason for this design is to reduce the moment of inertia by reducing the mass distribution. Thus, lower torque requirements are needed for a given angular acceleration and movement of the limbs utilizes less energy. Add to this the elastic properties of muscles and tendons and the body moves with even better cost-benefit relative to the tasks imposed[98]. As a consequence, the body moves in such a way that command signals from the CNS are simplified[99], that altering joint angles relative to movement increases stabilization[100] and movement patterns work to make movement most efficient relative to speed[101].

The above is brought forward for good reason: the body is very efficient in how it transfers energy in order to make movement more effective relative to energy output. In fact, it is so effective that it permits the ability for a person to lift more weight through mere means of adaptation to strength training exercises without a concomitant increase in hypertrophy. It does this as the nervous system communicates and commands the muscle fibers as to how energy is to be transferred between and among body segments (e.g., from gluteals to hamstrings), or even within the same body segment or muscle[102],[103],[104], viz., *inter- and intra-segmental dynamics.* In other words, there is a flow of energy into and out of various body parts and within each body part as we move, and particularly as we strain against an exercise load. This makes movement easier and the ability to lift more weight improved, as well, with practice.

And the heavier the load (and the more premature we become in increasing load), the more any excess strain is taken up by outlying muscles with their energy being transferred to the prime movers of an exercise. The same can occur even with lighter loads when there is excess contracting or straining of the outlying muscles. What then happens is that more load can be lifted because of this energy transference, but that does NOT mean that the target muscles are generating more force as a result of their contractile properties, but because of a flow of energy being transmitted by other muscles! This is no different than using ballistic stored energy to lift more weight, or the use of knee wraps, a belt and a lifting suit in powerlifting; more load may be lifted, but the strain and hypertrophy stimulating effect on the target muscles are no greater than it would be with a lighter load used more effectively and with greater targeting isolation.

One would think that participation of the outlying muscles would be a good thing, as it would stimulate growth in those areas, but that is not the case, and doing so simply cuts into recovery resources. To explain, consider if the thighs have experienced squats, leg presses, and leg extensions with hundreds of pounds for several repetitions, trained to muscular fatigue. If those muscles were to contract and stabilize in an exercise, such as the barbell curl, the thighs would experience a fraction of the strain and inroad when compared to direct, all-out training. As a result, the carryover tension to the thighs during the barbell curl is an inadequate stimulus to cause change in the thighs, but the thighs participation does allow one to curl more weight.

Hence, when bodybuilding, the goal should not be to lift more weight per se, but to make exercise harder relative to the load and then to increase the load when it is no longer of value insofar as to how the load is manipulated. Refer to the shaded section below as to what progressive overload means to Zone Training™.

How much a person can lift in any exercise varies, and is based on intrinsic factors, such as height, body and muscle shapes, muscle lengths and tendon insertions, and even nervous factors such as changes in synaptic connections. And then there are extrinsic or environmental constraints, with the influence of gravity on the working limbs being the most obvious, but also the influence gym temperature and humidity can have on performance. In any movement in and out of the gym, the human body (a system) will be constrained by intrinsic and extrinsic factors that shape the form of movement patterns and the ability to succeed in achievement of performance goals, e.g., the ability to lift ‘x’ weight for ‘y’ repetitions in ‘z’ exercise.

What All This Means to Zone Training™

We are aware of various aspects of human movement and exercise, and they summarized as follows:

1. Certain things helps us to lift more weight, including stored energy, muscular coordination, and the energy transference that occurs from one muscle segment to another, all of which are irrelevant to the contractile properties and the specific and hypertrophy-potential stimulus of a targeted muscle.

2. As per point 1, the body is a synergistic system that strives to work as a total unit and in the most economical manner possible, which means expending energy proficiently while reducing the need for added muscular hypertrophy.

3. Weights can be too heavy for an exercise, even if form is very strict, since the greater the load the more outside muscular participation (by way of greater stabilization and muscle synergist participation) and the more the factors mentioned in point 1 will have an influence on improved lifting ability. Excessive outside participation does not help muscle targeting, and it can reduce quality of target control and contraction due to excess strain and inability to squeeze and congest the trained muscle.

4. The greatest changes that result from strength training are improvements in exercise performance specifically, with less change in measurable muscle strength and hypertrophy response. Consequently, becoming better at an exercise, by lifting more weight, is no guarantee that muscle strength and mass are increasing or will increase (particularly as muscles adapt to the stimulus of the same exercises performed in the same manner).

5. Lifting weights can result in improved muscle strength with little hypertrophy effect; it can result in hypertrophy with little change in muscle force output; and it can result in both strength and hypertrophy, although the ratio will vary and often biased toward strength via neurological adaptation – which appear to affect both beginner and advanced trainees alike, although for different reasons. The cause for these variances is the result and is affected by the specifics of the exercise prescription as a whole (e.g., some methods of training can increase non-contractile protein elements that improve hypertrophy).

6. Further to point 5, a focus on the lifting of weights rather than the control and squeezing of target muscles will have a detrimental effect on the hypertrophy causing stimulus, particularly if heavy lifting under intense conditions reduces targeted stimulus (specifically) and set volume necessary to achieve favorable hormonal/lactate responses related to hypertrophy (generally).

7. Further to point 6, there is no evidence to support that progressive overload is the single catalyst for muscle hypertrophy, but that the totality of a program’s prescription must be considered. Moreover, as per points 4 and 5, evidence does exist that becoming progressively stronger on exercises does not necessarily cause or reflect greater hypertrophy.

Based on the above summation, let's consider this is a more broad perspective and the details behind the JReps™ Method in load selection.

A fundamental of exercise is that a load exists. In fact, it is impossible to exercise without a load of some measure since even the influence of gravity on our bodies act as a means of resistance. The concept of 'progressive overload' is not a fundamental to exercise, since exercise can exist without the load becoming any heavier. But in order to make improvements in strength and hypertrophy, progression of the load becomes *part* of the necessary milieu that constitutes the overall strategy to induce change. Because of this, progression in load is vital within the JReps™ Method, as it must be with any other strength training method. However, how progression in load is applied is an important consideration, and not to be taken lightly, but no more important than challenging the muscles by other means within the overall scheme of the total demands (e.g., fluctuations in volume and frequency).

Over-zealous increases in load (for the purpose of supporting the belief that change will occur only if there is more load) can reduce training quality on targeted muscles, encourages mechanical change and excessive full body contractile work (which increases energy utilization and recovery needs), and becomes an unfortunate means to an end of weight lifting as opposed to body building. Consequently, with JReps™, the directive is to use a load to the best of one's ability and in as many variations relative to an exercise as is possible. (The need for constant variation is supported by The General Adaptation Syndrome, discussed in detail later in this chapter.)

In effect, begin with the easiest patterns relative to an exercise, such as JReps™ Halves for biceps curls (top half followed by bottom half, and then bottom half followed by top half in a later workout), then thirds (with each zone performed in a different sequence, from easiest to hardest), etc. By altering how the load is used, by working an exercise in different zone patterns and combinations, a 100-pound weight can feel less or more challenging, and the constant change in Zone Training™ pattern dynamics provides both variety and a more difficult environment to which the muscles can adapt (or to keep from adapting). After all, muscles are not aware as to how much is being lifted, but the overall demands placed upon them, with the actual measure of the load being only one factor, whereas how the load is used being the other. This is no different than the rational behind using custom-designed machines, whereby 100-pounds is still 100-pounds, but the nature of the force curve alters the nature of the strain on the muscles.

Only when confident that you have done everything with a particular weight possible, when you no longer can make use of a particular load no matter the JReps™ pattern, should the load be increased. But it should be increased sufficiently as to induce a hard and unexpected blow to the muscles, to produce the most formidable stimulus possible for the best possible and probable change. In other words, avoid micro-loading unless given no other alternative. And then, that greater load is used expertly until it no longer has any value relative to one's new level of function and the various and potential JReps™ patterns inherent to the chosen exercise.

How much should the load increase? That would depend on the exercise and muscle(s) in question, and to suggest a 5% increase or some other measure is a bit simplistic and irrelevant across a broad spectrum of trainees and possible movements. Rather, the measure must be sufficient so that it is noticeably heavier, and yet the quality of overall movement remains intact.

If you are targeting a muscle, as one should in bodybuilding, aim to feel and control powerful contractions by squeezing into position and then easing back out, all the while keeping the outlying muscles as relaxed as possible and only as tense as possible to provide sufficient stabilization – but without over-working those outlying muscles as to enable the lifting of more weight that cannot be controlled and directed by the targeted muscles.

It is to be expected that greater contraction of outlying muscles will occur as a set becomes harder, although this effect is only apropos during the final few repetitions with Zone Training™. Even then, as a set becomes harder, and you notice greater contraction of outlying muscles, be aware to what degree this is occurring and that it be limited as much as possible. If outside forces and energy transfer feel significant, or to the point that it is obvious, then that may be a sign not to increase the load relative to the JReps™ pattern employed. If your focus becomes one of moving the weight rather than training the muscles with hard, controlled squeezes, then the load either should reduce slightly or stay the same until mental and physical control of the highest quality are realized.

Far too many people interested in making physical change are too caught up in how much they can lift (for 'x' repetitions), and although regular load progression and the use of as heavy a weight as possible (relative to the nature of the exercise and proper performance) is of value, that value diminishes if an increase in load reduces the direct strain experienced by the targeted muscles.

To elaborate, besides safety, trainees are told to avoid moving quickly and not to bounce the weight, since doing so increases momentum, which means decreasing muscle tension. Moreover, that same bouncing and quick movement also increases the participatory effect of stored energy and outside muscles. The same is true when the load is so heavy under strict conditions that outside muscles must participate and stabilize more than is necessary under proper and ideal training conditions. Likewise, if the application of a load is not imposed on target muscles properly, and there is a spill-over effect to other muscles, then the net effect one is trying to achieve, to overload the targeted muscles, diminishes. Therefore, the quality of training effect must remain constant regardless of a new load imposed.

As with anything in life, there are limitations and human function is finite, as is the ability of any particular muscle. Concurrently, as with anything, there is a ***tipping point***, as per the *Principle of Diminishing Returns* that upholds the fact that any more load beyond the maximum to place an optimum strain on a muscle (relative to the tension time and rep range desired) will cause that additional strain to spill over onto other muscles. This is no different than trying to fill a one-gallon jug with 1.25-gallons of water, and with exercise if all a muscle can sustain is a 100-pound load over the course of 'x' repetitions and 'y' tension time, then pushing it to 105-pounds will result in the outlying muscles taking over a portion of the work to help support that environment.

The above is evident when we consider that going too heavy results in the body cheating, squirming, adjusting, making mechanical changes throughout the range of a single rep, let along an entire set and from workout to workout. These obvious changes are not so obvious when progressively overloading by small increments and trying to remain as strict as possible. Rather than adjusting one's mechanics, with the presumption that one is remaining strict in his or her exercise, what happens is that the outlying muscles contract a bit harder to take up the slack of that extra load. Concurrently, what also happens is that the targeted muscle does not contract as well, whereby the sensation becomes one of a heave of the load as opposed to the target muscle working against and flexing against the load, as directed by the JReps™ Method. As stated, if the overall feel is more of the lifting of the weight as the body coordinates as a whole to lift it, as opposed to the training of a muscle, the weight likely is too heavy for physique development purposes. At the very least, hypertrophy potential will decrease.

To reiterate, you need to stabilize as little as possible and as much as is necessary, and no more. That quantity and quality is subjective but must be tracked from workout to workout. With this in mind, as the loads progress there must be some consistency in how much the body works in general to maintain proper form and while allowing the targeted muscles to work as hard as possible and, at the same time, consistency in how well the targeted muscles contract, since too rapid a progression in load reduces targeted muscle contraction quality.

Moreover, and this is the crux of the issue, since excessive loading will do nothing more than increase strain on outlying muscles, this further means an increase in generalized strain and need for more recovery, both of which can hamper training productivity and one's end results. It is no coincidence, then, that Zone Trainees who learn to isolate and relax experience significant muscle inroading without the same degree of systemic strain experienced by weight heavers.

Furthermore, what we see with most trainees, regardless of exercise philosophy, is a preference toward key exercises in which they excel, and this offers the ability to increase load far more frequently, but this is not necessarily a good thing. If loads increase regularly because of ideal situations (i.e., body shape or limb length), then training is simply more favorable to the conditions and abilities of the body, and this means less challenge to stimulate hypertrophy. The muscles then adapt more easily because of the favorable exercise environment. Conversely, perform exercises that feel more awkward (not necessarily uncomfortable), but those exercises that cause the body to struggle more than usual when trying to progress the load, and you will find that hypertrophy training becomes more effective because of the superior agitation and demands. This is important to understand since we're not talking about honing skills to make the body more fluid, as in gymnastics or some other sport, but forcing the muscles to become larger by making them the *least complacent*, as per the General Adaptation Syndrome. Doing what you're good at, with an emphasis on being good at an exercise, such as the bench press, is only good if you compete in hoisting heavy weights of those exercises.

Finally, it is unfortunate that bodybuilding is so rife with drug use. And, of course, the biggest drug users also are those with the best genetics. Both the issue of genetics and drugs make it more challenging to observe what is most effective in regard to exercise application and stimulating hypertrophy. Nonetheless, a review of bodybuilders from previous generations would conclude that they used weights as a means to develop their bodies, and their methods allowed them to induce hypertrophy without an equal change in lifting proficiency. This is how the stereotype "he's not as strong as he looks" came about, and there is truth to it. Many of today's bodybuilders do not use weights that would reflect their muscular size, as they put as much emphasis on volume, frequency, multi-angle training, achieving a muscular pump and congesting the muscle to stimulate non-contractile hypertrophy*, and developing sufficient fatigue as they do in how much they lift. Today, there is far too much emphasis on how much weight is lifted for a desired repetition range, rather than how it is lifted and the overall effect it has on the targeted muscle and this has resulted in frustrated trainees who are confusing the issues of muscle development with lifting proficiency. Zone Training™ is an effective solution to the problem, but only if the method is applied appropriately and in accordance to its underlying tenets.

A Note on Muscle Activation

Rapid movements are generated by rapid impulses of force via signals that travel along the length of a nerve fiber, being the means by which information is transmitted through the nervous system. As speed of movement increases, the magnitude of the impulse required to accelerate the limb must increase[105]. This, in turn, activates more motor neurons and fires a greater number of fibers relative to the load, but moving too fast will increase the risk of injury and instability[106] if training under traditional means of full-range exercise (and which is affected by ballistic action or excessive stored energy rebounding).

For this reason, the hard, yet controlled contractions during Zone Training™ exhibit rapid movement, but with the short pauses at either end of a zone there remains control and optimum muscle tension. Moreover, the directive to relax as much of the outlying muscles as possible (maintaining tension only enough to ensure sufficient stability) necessitates using a more appropriate load relative to the targeted muscle, which means less strain experienced overall than if integrating more outlying muscle to 'heave' heavier loads.

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* For example, a 2006 study found that loading a muscle and training it to fatigue under conditions of vascular occlusion (trapping and limiting blood supply to the area) increased growth hormone levels four-fold – a better response than if using heavier loads without occlusion. Now, consider the issue of muscle pump and *ischemia*, the latter of which is defined as a temporary deficiency of blood flow to an organ or tissue, caused by diminished blood flow either through a regional artery or through the circulation (*Tabler's Cyclopedic Medical Dictionary 20th ed*).

This type of occlusion is what occurs when a bodybuilder pumps a muscle to extreme levels in minimal time, and is particularly noticeable with short, cramping-type contractions (similar to what one finds with JReps™. This evidence supports the notion that how a weight is used, and not necessarily the magnitude of the weight, is important in optimizing muscular growth. Reference: Reeves GV, et al. 2006. Comparison of Hormone Responses Following Light Resistance Exercise with Partial Vascular Occlusion and Moderate Resistance Exercise without Occlusion. *J Appl Physiol.* Aug 10.

Another 2006 study also found that 'local hypoxia' (decreased skeletal muscle oxygenation via impaired blood supply) may be a stimulus for muscular hypertrophy. This can be caused by constant tension training and congesting a muscle with a big pump, viz., achieving a maximum pump under very intense, high tension conditions. Reference: Toigo, M., and U. Boutellier. 2006. New fundamental resistance exercise determinants of molecular and cellular muscle adaptations. *European Journal of Applied Physiology.* 97: 643-663.

A Fitness Clinician's Perspective on Proper Loading

By Andrew Shortt

Load matters…if it is selected well.

Whether you train yourself or others, load selection is a primary. You determine how much load you can use and for how many reps/TUT (time under tension) in any given exercise. Then, as per the principle of progression, you work to lift more weight and possibly for more reps each time you train.

This sounds straightforward and even simple when described as such, but after decades of practice I know better. I know that non-muscular growth adaptations are every bit as much a part of the picture in regards to perceived increases in strength and function as are gains in raw lean mass.

These supposedly objectively measured increases in strength (more weight moved and possibly for more reps) can and are very deceiving at times. With the advent of Zone Training™ and its inherent ability to better fine-tune load to each and every individual circumstance (as needed to truly promote muscle growth), it has become more obvious than ever that we need to reconsider how we select load.

Skill is highly specific to the task practiced, whereas muscle is general in nature in the manner in which it enhances function. This means that the goal of exercise for real strength training is to build muscle mass, mass that can be used in any circumstance and not just lifting weights in a particular manner. We need to avoid wasting our limited energies and resources on becoming skilled in our lifts… skilled beyond what is needed to 'play safe.'

Furthermore, real fitness is based primarily on your level of functional ability (what you can and cannot do physically), and your body composition (percentage of bodyfat or ratio of body fat to lean mass). Theses aspects support endurance and resilience against stressors in life. Both of these aspects are handled best with the effective building and maintaining of lean mass. To build lean mass we must load the musculature to a high degree, right? That is correct, but just how do we do that, or how do we know we have done so with any real degree of effectiveness?

It is astounding how many folks I deal with that think that so long as their basic form is sound and they can keep adding load from time to time, all is well. Fine and dandy for the beginner, but this is far from what is needed beyond the basic stage of physical development. Certainly such is less than required to fight age related muscular atrophy or deal with the serious issues of rehabilitation.

The Net Effect Often Is Gross

What is needed is the discernment of 'Gross Load' verses 'Net Load.' Plainly put: how much of the actual load with which you are working is experienced by the targeted muscles (that is, the muscles you are trying to train/target at any given time with any given exercise selection)? More to the point, how much of this load is being handled by what muscles at any time in a given exercise's range of motion (ROM)?

Most people understand that the muscles do not work in isolation from one another, even when isolation type exercises are performed. The body works together in its energy systems, CNS, connective tissue, skeletal structure and ultimately its musculature to achieve movement. Posture, position, timing, momentum, inter- and intra-muscular coordination, etc., all unite to complete physical tasks. From scratching an itch between your shoulder blades to hoisting hundreds of pounds, it is all a synergistic effort on some level but just to varying degrees. More explicitly, if you force yourself to complete the same task repeatedly, your body will adapt and adjust to make the task less energy draining for the sake of successful survival. This is basic evolution, whereby to become better at surviving we must become more efficient wherever and wherever possible.

These two things need to be understood, not just as static facts but how they influence all the other aspects of exercise. We need to understand that simply lifting heavy stuff is not the point of anaerobic exercise. The key is proper loading of the muscles we wish to enhance in any given exercise. The problem most run into is they tend to think that all the muscles working in any given movement will benefit from the stimulus. While this may be true to some extent for the rank novice, it is not the case for those past the beginner phase of development. Thus, it is not the case for those struggling to maintain their musculatures against outside forces (age, sickness, etc.), nor is it advantages for those wishing to optimize their physiques.

We need to be acutely aware that at some point the coordinative effects of the body work to share the load, so much so that effective loading on targeted muscles is really quite tricky at times. The body becomes familiar with motor patterns and fine-tunes them while the rest of the systems adapt to be more energy efficient as well. This is, in part, what causes the standard slowing of progression in one's growth (plateau). Basically, as far as the targeted muscles are concerned, with time and practice 'load is lost.' You may be able to add small amounts of weight from time to time, but the muscles in question will not experience effectively the higher resistance, or will not be working with it through any sort of meaningful ROM and/or TUT.

At an experienced intermediate and advanced stage, a new plate (or two) pinned on the leg extension most often will be taken up for the most part through bracing, coordination and outlying musculature. Better shifting of effort through coordinative timing and balancing will account for the higher numbers we so greedily record in our journals.

Don't believe it? Well, why has your favorite lift gone up 25-45 lbs in load, and yet the muscles you think are responsible still look about the same? Why can we often lift literally 20-30% greater weight (over a few months) in simple moves like an arm curl (even under fairly strict form), but the supposedly targeted muscles are left virtually unchanged? Do you have many stagnant lifts and stagnant muscles? Just micro-load your weights and see the poundage's rise, and yet after several weeks no new muscle mass appears.

Fluctuating body fat levels and varying glycogen retention make it difficult to notice minor new muscle growth or loss. However, if over much time (let's say 6 months) all your loads are up several pounds from previous numbers, and there is no real increase in your lean mass, what then? I have seen it more times than I care to remember, especially in my personal history.

Zoning In On Load

Once I began Zone Training™, I not only gained new muscle but I could feel the difference immediately. The difference was far better targeting and isolation in each of the muscles I trained. The more I broke down every ROM into zones and squeezed and pumped them like a piston, the better it got. The results were obvious and a major part of it was effective loading. I found I could regulate the amount of volume and intensity my muscle received better, as well as more thorough work and fatigue throughout my muscles' full working ROM. It became apparent that load and the effort to work with the load were being distributed better. I didn't really notice it at first, but over time I became acutely aware that I had been draining my body with full ROM reps, too much energy expenditure using outlying musculature and skill to handle parts of loads at varying points in an exercise's ROM. I could feel that when working in zones I could stop passing the buck and place the better part of a load on the targeted muscle instead… that or I would need to and could reduce load for that zone (or reduce/increase cadence, rep count, etc). That I then could effectively adjust as needed to keep the required load on said muscle(s) at all points in its ROM became obvious, and that I could do so without expending extra time or energy. A piece of the puzzle was in place and the resultant reaction was downright astounding.

I had always been aware that I needed to avoid wasting too much time and energy moving loads (no matter how safely) that were too much of a coordinative effort. As a trainer, I knew that the indirect effect was fine for the beginner but that to achieve any real level of fitness one needs direct and demanding work throughout each muscle's full active ROM (or close to it). Sure, heavy multi-joint lifts and limited heavy ROM training could produce some effect, and that is not being disputed, but for those of us devoid of rare-above average genetics for being big and strong (mesomorphs) much more is needed. For the very low percentage of highly athletic, solid jointed, muscularly dense types, such training might suffice but not for regular folk. Those with long muscle bellies and large amounts of the right muscle fiber type with good recovery abilities might get away with basic grunt work, but such is not common by any means, and I don't believe that even those genetically gifted individual will *optimize* muscular development with such training practices. The standard issue human needs careful and specific loading to the musculature to achieve good levels of fitness, especially as we age. Certainly, to achieve high levels of physical ability one needs more than pushing and pulling as much as he or she can, regardless of ROM or exercise choice.

Even if you are far from convinced that Zone Training™ is a great method to build muscle, getting good at it will be an education. You will feel the difference between muscles loaded by just adding ever-greater amounts of 'external' load (gross load) and when a muscle truly experiences increased 'internal' load (net load). It may take adjusting cadence, zone size, angle of attack, general body position, rep count, order of zones, order of exercises and, of course, amount of load, but you will feel it. One simply needs to (at least temporarily) apply greater focus and concentration on feeling targeted muscles work to become awakened to the true depth of the issue.

I practiced feeing and isolating my muscles as they cranked out the reps in each zone, looking for a greater stimulus for growth. I was not specifically looking to feel the effects Zone Training™ had on achieving effective 'net loading.' This was a byproduct of doing all I could to isolate and deeply fatigue a muscle by placing as much strain on a muscle as I could handle for a reasonable rep count. Time and time again, when I worked with full range of motion reps I could spot a distinct difference. Sometimes the load for full ROM reps was fine but as fatigue set in isolation and targeting reduced. Something other than the chosen muscle(s) was taking up the job and the stimulus become lack-luster. The more I paid attention to how well a given muscle was loaded in any particular part of its ROM during an exercise, the more obvious it became. Close attention to flexing, squeezing, hard contracting, feeling the stretch and the stop at turn-around brought out a nuance of the details I had been missing.

This is not to say that outlying musculature and skill cannot, at times, be of value, just as a variable-resistance cam or even a partner or free limb assisted forced rep can be useful. They can be of value, as we have experienced with the squat and how great it stimulates thigh growth. Though much argument revolves around leg extensions and leg presses as opposed to the effectiveness of squats, the fact remains: Squats, even though far from an isolation type move, can and do stimulate major thigh growth. In fact, for me and many of my past and present clients, the squat and its little cousin the lunge make the difference between mediocre thighs and very well-developed ones. However, even though such moves allow for major load applied to the thighs because of all the coordinated movements at work, Zone Training™ will make the movement better…a heck of a lot better. In fact, squats in conversation about effective loading are an excellent example with which to take advantage.

Does the Load Mean Everything, or Does It Mean Squat?

Anyone who has squatted, or lunged for that matter, knows that what they can handle down deep, where their thighs are near parallel to the ground is far less than what they can work with in the top half or third of the movement. I easily can work the top half of a squat with 400 plus pounds, but said weight would see me stuck squashed on the floor if I lowered myself too far. The leg press is no different, whereby you would probably be hard pressed to load even the basic sled with more weight than you could handle safely through the top half of the exercise.

This point makes it abundantly clear that working the top of a squat with far more load, followed by less load in the bottom is more effective than using only one set load for the full ROM. Why limit the amount of load on your thighs to what is appropriate at the bottom of the movement? Why spend only brief time loading the bottom area of the squat because of the amount of load forcing you to rest during the top half of the move? Why not simply train the bottom half with one load and the top with another, then mix in full ROM reps at varies loads from time to time for variety sake and to test your ability in the move and in a traditional manner?

Now, of course, the most eminent 'breakthrough' in exercise science to encourage proper loading has been with well designed machines, to help isolate muscles. And with the addition of cams, they vary the level of load as need throughout an exercise's active ROM. This was a big step forward, but the fact remains that when performing full ROM reps, whether in a braced machine or with a well practiced free weight movement, the results were comparable, and one no better than the other. Likely machines were and are safer and they get a beginner progressing faster, but what of more advanced achievements? What of slowing regression of lost muscle while aging and enhancing rehabilitation? Heck, what of plain old want for optimizing muscular size!?

Muscles simply don't work the same at varying lengths and at different joint positions. Furthermore, the effects of cumulative fatigue during a rep, set, and from exercise to exercise cannot be accounted for with only full ROM training. This is likely why free weights, over the long term, produce the same results as the best of machines. Bottom line, basic results achieved by almost any manner of progressive weight training is not the issue. Real fitness, i.e. bodybuilding/body maintaining comes from pushing well beyond the basics. No matter how you slice it, a body grown 45-55 lbs in lean mass will sustain far more than one grown 15-25 lbs in lean mass (or a comparable ratio in lower amounts for woman, elderly, etc.). A method that allows you dramatically to reduce the amount of 'help' a targeted muscle needs means increased resources for growth and maintenance. A method that maximizes muscle growth stimulus will have the greatest net effect on coming back from injury and staying fit in the face of the rigors of life.

<u>Some</u> fitness and <u>some</u> muscle from any traditional means is fine, but when age sets in and begins its incessant whittling away at your musculature, what then? Will you just lift lighter loads as you get weaker (and weaker) or will you look to load as efficiently and effectively at all times, trying for two steps forward to stave off the three steps back that comes with age?

'Brace' Yourself for the Truth

Rather than talk too much around the issue, let me be more specific for a moment. During my many conversations with trainees and trainers one issue tends to stand out about all this: They feel that where no real movement of the body is perceived (squirming about to eke out another rep), there simply can't be significant cheating/assistance occurring and, thus, as long as a machine is reasonably well-designed or a movement technique well practiced, net load is not an issue. Where they don't see the assisted action or feel it to any great degree, it must not exist at any important level.

The problem here is that feeling is subjective and subject to distractions and interference (noise) produced by the strain of exercise, as well as the confusion created by all the dynamic elements working at the same time. Furthermore, people tend to think of physical assistance in a lift as being a visible action of sorts. Actual body movement can be minimal, and yet the squeezing and tensing produces substantial support and aid to completing a rep successfully.

Consider an exercise like an arm curl. As soon as fatigue sets in it is impossible not to make a point of utilizing a bit more back, forearm, shoulder even midsection strength to brace the action and keep it moving through its toughest zones, if you push yourself to the limits. The nearer you get to muscular fatigue, the more your body calls upon a steady platform from which to work, as well as a slight force at certain brief moments during the rep and as you pass through different points in the ROM. Even from the outset of an arm curl, the load may be high enough to require assistance through the most difficult zone, and yet little or no help in other positions. This zone or sticking point can start as a very small portion of the total ROM then grow over time as fatigue sets in. As fatigue increases, aid is needed ever more, and no matter how hard one tries to relax outlying musculature and target the biceps, the rest of the body works progressively harder to hold you steady and support you through the weakest areas. This is a big issue because to load your biceps fully at every point in the ROM may necessitate help in points that have already reached their max ability due to load and/or cumulative fatigue. This means help is turned on to keep things going and isn't likely to turn off to reload at other points in the ROM, especially as major fatigue sets in.

I see this effect all the time with clients learning a new exercise. Once they have become proficient enough to work the exercise safely and against noteworthy load, I then have them learn to zero in on the targeted muscle. With full ROM reps, when I reiterate which muscle should be targeted and they try to isolate better, a funny thing often takes place. Initially they feel weaker in the move because of my instructions, even if the recommendation is to use a bigger stronger muscle more than a weaker one (i.e. the lat/back instead of the arms during pulldowns). What I see is they have learned to coordinate their muscles to act in a well timed fashion, shifting load among the muscles involved, in a fashion that comes easiest to them and relative to their experience and body shape/inherent qualities (limb length, etc.). They have achieved good form and can handle a decent load, but when trying to place the bulk of the burden of said load on the targeted muscle, it is quite awkward at the outset. Until they learn to work more with the targeted muscles and let off on the coordination/skill aspect of the move, they feel temporarily weaker. The observation certainly is pronounced more with free weights and cable moves, but exists in fixed moment arm machines as well.

This brings us to the point in the discussion whereby we inevitably are drawn to the issue of machines in general, machines that brace and help isolate muscles (as well as offer variable resistance). The problem here is multi-dimensional, but I will address the two most obvious issues briefly.

First, you can never isolate a joint function or muscle action totally. Muscle are not laid out in separated and perfectly straight lines, and even during many of their main functions they work with other muscles to a lesser or greater extent at various points in the action's ROM. Basically, muscles do not work alone; they work in accordance with joint/skeletal function and in conjunction with other musculature, and the degree to which they work at any point or plane of movement always will be relative to one's fatigue and overall and unique architecture of the involved muscles and limbs. You simply cannot target a muscle completely throughout its full ROM, moving continuously from full stretch to full contraction. They are not designed that way. Thus, regardless of machine design, if there is movement there is more than one muscle at work. Consequently, even in a machine the issue of outlying musculature providing undesired help is an issue.

Second, the act of bracing and resisting shifting, twisting and stretching does provide considerable aid in movement. In fact, often the more braced a muscle is the more it can help to sustain movement. Think of it as a fellow helping move a heavy object along over everyone's head, as it passes from person to person. He barely pushes on the object as it passes by, but the better braced he is the more force he can add to the action and the greater help he is. However, in this case, too much help is cheating you of proper net load and, thus, appropriate fiber recruitment, fatigue, and so forth. When a muscle holds statically and helps resist the lateral shift of a limb, or helps reduce twisting of the skeletal structure, it helps and in a big way. In addition, this act of pushing or pulling from a compressed and braced position can be very dynamic if worked in an on-and-off fashion with other outlying muscles.

Consider a lying leg curl or pec deck flye motion. In the curl the body can push back on the thighs, timed with a static torque of one's back (to avoid twist in the torso) before or after the abs contract and flex the spine to push back against the pad under the stomach. Heck, just grip the handles of a leg curl or leg extension and compare with not holding anything to witness the effect.

Even with the fly/peck deck motion, the shoulders will assist (even when shoulder blades are held back and chest kept high), as will the back and waist. They contract and push/pull back against the load as they hold position and help work the load along to a full contracted position. In fact, as the arms fight shifting (to hold position) in and out and up and down, all of it can happen in a timed sequence with back, abs, shoulders, etc., which assistance brings the moment arms together. You could be trying to perform a bit of internal rotator motion for a brief moment and miss it altogether, but it helps you cheat. Try as you may to isolate the pectorals in this well-isolated movement and you simply cannot. This is due in large part because you do not require the same help, if at all, during all reps and at all points in an exercise's ROM. The help comes and goes during the strain of exercise and does so in such a coordinated and lightning fast fashion that it remains imperceptible for the most part. Imperceptible that is until you look for it with earnestness as you work each point of a ROM in small bite-sized portions, one zone at a time.

The muscles are quite strong as they work statically and in very small ROMs. This is due to the effects of cross bridge dynamics and such, and allows for plenty of help to keep full ROM reps moving. The more you reduce the ROM of an exercise, the more you can avoid using this help and place greater load and emphasis on the target muscle. The more you can keep skill acquisition and inter/intra-muscular coordination down, the closer the net load comes to matching the gross load. With the act of bracing as a cheat, it is important to keep in mind that the closer your muscles work toward their center of gravity, the greater force they can provide. As well, the more solid their platform/bracing points (bench or machine pads, etc.), combined with moving very little distance, the stronger they can act.

Furthermore, the action of a cam to vary resistance does not guarantee proper loading, since muscular dynamics change while a muscle shortens or lengthens. They (cams or other variable resistance facilitators) simply increase or decrease load as position is stronger or weaker in relation to the workings of the given muscle or muscle action combination. This does not mean that help isn't increased (beyond what is needed or desired) in the harder sections, and still helping as you pass through the lighter less peaked portions of the cam profile. You don't turn off the body's ability and desire to make actions more energy efficient by simply reducing load as you go. You need to deal with each changed point as a separate circumstance with its own individual needs. Many times it is the dynamics experienced before and after a certain point in the ROM that powers one to cheat more. The dynamics include fluid pressure, the effects of cumulative fatigue, and the build up of metabolic waste by-products as a rep and/or set progresses.

Sometimes it is worthwhile and helpful to squeeze a handle or contract one's abs to aid in an assisted rep, but for the most part it is a waste of energy if you wish to maximize muscle growth. The real concern is how to decide properly when aid is helpful and when it is intrusive, which is of course where Zone Training™ comes in.

My Workload

As a professional trainer, I find it a daily challenge to detect how well my client's muscles are loaded. I can try to judge by the numbers and their physical demeanor to assess performance, but that is all it really amounts to…a performance. That wonderful and instantaneous element of feel provided by our lighting fast and super sophisticated CNS is missing, because I am not them and interrogation can only render so much (as well as being slow and cumbersome). Rather, I thoroughly appreciate taking advantage of breaking down every client's muscular ROMs, and in every exercise and reforming it into bite sized portions to ensure better proper 'net' loading; better net loading and not just increased gross levels of resistance, the latter of which often contains gross extraneous load that requires valuable energy to be squandered.

Unquestionably, JReps™ allows for more contractions per unit time. Certainly it enhances the mind-muscle 'feel' based connection, thus enhancing isolation through tracking the same short ROM many times in a short period (with the help of concentrating on squeezing, contracting, flexing, and stretching). Of course, the increased burn and pump make 'feel' more acute and, thus, targeting easier, but those come down more to proper bodybuilding technique and good regulation of volume to gain deep fatigue. It is proper loading that is a primary of anaerobic muscle building exercise. To that end, it doesn't matter how much weight you use; what matters is what you can get <u>on the muscles</u>. How much load you can apply to the muscle for an appropriate amount of time and while minimizing superfluous energy drain as much as possible.

Those who speak out against Zone Training™ fixate on it being some sort of fancy rep scheme and rep performance technique. They regurgitate the same entry-level info time and time again *" heavy loads and hard work are what get the bulk of the work done."* The ridiculous aspect of this is that we agree on the issue of the importance of load…entirely! We always have and likely always will. The developer of this method holds this credo, and certainly I have always worked to train as hard and heavy as possible. We have sustained the drain and the pain to do so and have done this for the most part unrelentingly through the years. We have never really tried to train lighter and with less effort but we have noticed that doing so has, at times, surprised us and provided new gains. The fact is, though, training lighter and not all-out was not the catalyst for growth. We discovered with JReps™ that what we were doing (training with less intensity and more volume) was freeing up some recovery resources and loading certain muscles at certain points in their ROM better. By easing up with load and effort *a bit* we actually were able to place greater load and more effort into certain points of certain movements, and possibly do so with a more appropriate amounts of volume.

The fact remains, though, that training very hard with max loads (relative to proper volume, etc.) is most often more growth stimulating than going lighter, longer with lower intensity. Extreme volume with lighter loads, and possibly a major increase in frequency, can be a new growth inducement, but as with all such extremes the effect is short lived. Contrary to what many load and intensity fans think, Zone Training™ at its heart has little or nothing to do with rep schemes. Variety is a whole other supportive issue, and so we go for as much as possible, but at the foundation of JReps™ you will not find rep schemes. You will find a method that makes it easier to overload your muscles while still affording needed levels of volume and freeing up resources to make effective frequency/volume possible, and with a reduced risk of overtraining, even when training all out all the time. (*"I refer to Zone Training™ as Bodybuilding Synergy… a hybrid of methods that takes advantage of the strengths of both high-intensity and high-volume while eliminating their inherent weaknesses."* Brian D. Johnston).

With JReps™, we are not prescribing any specific rep scheme, rep performance, set list, or exercise arrangement. We are working just as much to handle the greatest possible load as we are trying to achieve the deepest possible fatigue. The type of fatigue we want only comes from very heavy loads for short anaerobic set times. The type of stimulus we want is one that calls on the greatest number of muscle fibers that loads and strains them to the max, and drains them as completely as possible in the briefest time. To accomplish this we have discovered that rep execution is best reduced to short range zones, and that continuous partial contractions work better than full ROM reps. Not the full ROM reps aren't effective; they are a times, but within straight sets start to finish, they leave much to be desired. There are moments when the full ROM of an exercise is 'the zone' but it comes and goes and we make sure not to become entranced by it, regardless of how much weight we can demonstrate as lifted effectively. We stay away from (circus) performing during our sets, regardless of how much it displays our lifting prowess. We don't cling to any momentarily effective zone technique anymore than becoming heavily reliant on the exhibition of how much we can move through a full ROM rep in a pet exercise.

Natural Selection

What we are doing with the use of this method is constantly adjusting how we break down all exercise selections, and then work it in zones. A large part of the reason we do this is to work around the effects of cumulative fatigue, skill acquisition and gross helper action of outlying musculature. We do this to keep the greatest amount of load possible on the targeted muscle(s) and out of the hands of the rest of the body (and various sub-systems) as much as possible. By working through short range reps, we face far less need for coordination and disallow too much of the shifting, bracing and (for lack of a better word) 'cheating' inherent in all full ROM reps. Whether a full ROM rep breaks down its quality from the outset of the first rep (too much load) or during a set (from too much load + fatigue), <u>not adjusting one's exercise environment is a huge mistake</u>.

There is no reason why you cannot try breakdowns, rest pause, static holds slow and/or heavy negatives, forced reps, strip sets, and on and on to deal with this. The fact remains, though, that these all offer only minor assistance. The main point is that the body IS designed to work to make things easier, and given just a little time it will spread around the burden of strain or refuse to progress at all. The only other option outside Zone Training™ is to risk injury by pushing the limits by accelerating loads through the sticking points, and even then wild loading as performed in explosive styles of training have major limits. Once you become accustomed to overloading and certain muscles working in a particular manner at certain points in their ROMs (and with the use of momentum and honed skills of multi joint coordination), the effects dry up. Weak links either break or hold you back, and you need to work them directly at particular ranges in their motions to assist the explosive lifts. And so, in the end you come back around to working with partial ranges in an isolated and targeted fashion once again.

Why not work, analyze and feel all aspects of all of your trained muscles as they contract and stretch during all points in their ROMs, and against all sorts of loads during all types of different exercises? You can, and you can learn to determine how to overload a muscle best and to the max without giving up so much energy, without playing so much hit and miss, hoping the job has been accomplished.

Break it down and work it in zones and pay attention to how much strain actually is on your targeted muscle during a set and as fatigue sets in. There is nothing wrong with a bit of kinetic chain assistance here and there, but too much will totally ruin your chance at gains. Too much load at the wrong time in the wrong position is just as useless as too little load during the same. The net effect of ignoring how the body desires to cheat, even beyond what is perceptible to the naked eye during supposed ‘sound/safe form’ is a mistake. It is every bit as much a mistake as thinking ‘more is better,’ because more is only better if quality is not lost. Moreover, and from this homegrown bodybuilder/full-time trainer’s point of view; *“less is best unless you have to give up gains.”* I believe in safety and efficiency as mature primaries, but not at the cost of always just playing it safe. If you want something better for yourself there always will be an element of risk to it, even if that element means experimenting outside the box and breaking bad habits.

Recap and Recapture the Load

As far as proper loading is concerned, look at any exercise movement and how it contains many different interactive elements: Different muscles working to diverse degrees at various points in a movement’s ROM. Look at the dynamic ever-changing aspects of an exercise as a muscle contracts and lengthens. Look to basic muscle function and how your muscles work differently at different lengths and as fatigue sets in. Perform any physical task repeatedly and note how you become more efficient even though your mechanics may not change, or changes very little. Endurance, tolerance to discomfort, coordination, concentration, better bracing… timed better for when it is needed all exist. Dozens of imperceptible adjustments are made every moment of every set because the CNS is so powerful, complex and diverse in it abilities. It reaches every aspect of our beings, both voluntarily and involuntarily, and is at the very core of the greatness of our abilities. The fact remains that exercise is <u>not</u> about making movements and tasks easier… it is about plain old hard work and always should be. But by hard work, the concept is not limited to hoisting heavy weights and straining as hard as possible, since hard work also must be smart work to achieve optimum gains in the gym.

Overloading a muscle is important to call upon the greatest number of fibers and fatigue them within the anaerobic threshold (as well as micro damage and hormonal considerations). It is so important that one must not overdo it at the expense of unwarranted reliance of creating physical movement <u>other than contracting and stretching the targeted muscle.</u> The act of losing net load (regardless of gross load) through inter- and intra-muscular coordination, etc., is not ‘cheating’ per se in daily life, but it cheats you of gains during exercise.

To stimulate a muscle to be bigger and stronger it must be loaded and worked hard (fatigued/damaged). Not enough load will have the muscle needing far too much work to stimulate optimal growth. Too much load will force a situation of not enough work (for the targeted muscle) to stimulate maximum growth potential. Too much or too little load will require supportive systems to be too overworked to get anywhere near an effective amount of stimulus (without pharmaceutical assistance, and even then gains won't be optimized). Novice and early intermediate gains will be garnered at best, then a lifetime of virtual maintenance and complaining of 'poor genetics.' Possibly, as much by chance as design, you may see minor additions to your lean mass but then age will creep in and short circuit the process.

Zone Training™ is an essential tool, both to create proper loading and, more importantly, to make it more likely you will know what proper loading is and when it is achieved. Yes, 'when it is achieved.' We are far from being so egotistical as to assume that purely through Zone Training™ that our muscles and those of our clients are always perfectly loaded. The reality is far from that, but with the degree of results we are realizing, relative to using only traditional full ROM reps and some incidental partials, the difference is marked. Load selection is easier and the resistance/weight better handled.

At full risk of sounding coy, the net effect of using Zone Training™ to balance load against the other variables is a big step forward in productive exercise. Regardless of how 'loaded' that reads, the fact remains that we and our clients are less drained, yet achieving better muscular growth and easier muscle maintenance. We certainly have not lost any muscle (it was not a short-term solution), and you can 'take it to the bank' that we have tried most everything that has come before this, and if JReps™ did not work better, it already would have been a thing of the past.

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