My First Half-Century in the Iron Game

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Exercise is usually performed for the purpose of improving functional ability, increasing strength, endurance or flexibility; for bodybuilding purposes, increasing muscular size is the usual goal, with little or no regard for changes in strength, which is a mistake because muscular size and strength are closely related.

Which does not mean that a man with large muscles is always stronger than another man with smaller muscles, because a number of other factors apart from muscular size are involved in strength. But it does mean that if you increase the size of one of your muscles it will then be stronger than it was when it was smaller.

A large part of the confusion on the subject of strength comes from the fact that the scientific community has never even defined the term; just what does "strength" mean? To a degree, the ability to lift a certain weight is a demonstration of strength; but it is also a demonstration of skill, so increasing your ability to lift a given weight may be a result of an improvement in skill with no actual change in strength. Thus it follows that a meaningful test of strength requires a procedure that does not involve skill.

The leverage provided by the joint system is another important factor; just how much weight you can lift is influenced by the distance that the weight is lifted, so having short limbs is an advantage for a competitive weightlifter because he is not required to lift the weight very far. Thus it follows that you usually cannot meaningfully compare the strength of one man to that of another man; but you can compare your strength today to what it was earlier.

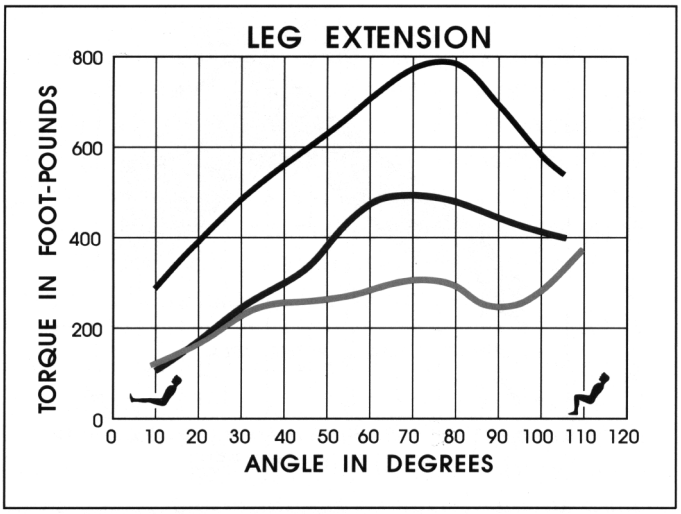
Strength is also influenced by the type of fibers you have in your muscles; while there are several different types of muscle fibers, they can for all practical purposes be divided into only two categories; "fast twitch" or "slow twitch" muscle fibers. Fast twitch fibers are capable of producing very high levels of force, but only for brief periods; slow twitch fibers cannot produce high levels of force, but have a lot of endurance. So it is an either/or situation: a lot of strength or a lot of endurance, but not both.

Most people have a mixture of fiber types, some fast twitch and some slow twitch; but some people have a very high percentage of one type or the other, and both their strength and endurance will be greatly influenced by this factor. Large muscles with a high percentage of slow twitch fibers may not be as strong as smaller muscles with a high percentage of fast twitch fibers. And just how important is this factor? The following illustration provides a dramatic example of the differences in strength resulting from differences in muscle fiber type.

About seven years ago we were visited by a man named Fred Hatfield, who was then editor for one of the Weider magazines and a man that had been training hard for more than twenty years; his primary interest was competitive power lifting and a few weeks after his visit he set a record with a squat of more than 1,000 pounds.

During his visit we tested the strength of his quadriceps muscles with a three-part procedure; first we tested his level of fresh strength throughout a full range of movement; second, he then performed an exercise that was continued to failure, continued for as many repetitions as possible until he was momentarily incapable of additional movement; third, immediately after the exercise we tested his level of remaining strength. Such tests are conducted primarily for the purpose of determining muscular fiber type; most people, those with a usual mixture of fiber types, when tested in this fashion will lose about twenty percent of their fresh level of strength as a result of fatigue from the exercise. Assuming that they fail after ten repetitions of the exercise.

But tested and exercised in an identical fashion a subject with a high percentage of fast twitch fibers may lose as much as eighty percent of their fresh strength; while subjects with a high percentage of slow twitch fibers will show little or no loss of fresh strength as a result of fatigue.



Based upon considerations of sex, age, muscular size and previous exercise experience, subjects with a high percentage of fast-twitch fibers will be much stronger than expected, but will have very little endurance; subjects with a high percentage of slow twitch fibers will be weaker than expected but will have enormous endurance. Such differences in fiber type are a result of genetic factors and are not subject to change; although fiber type will sometimes appear to change, because atrophy (both disuse atrophy and overuse atrophy) is selective in regard to fiber type, fast twitch fibers atrophy faster and to a greater extent than slow twitch fibers. Thus an atrophied fast twitch subject may appear to be a slow twitch subject when first tested; then, as strength is increased in response to exercise, his fiber type will appear to change. But this is a misleading impression; no actual change in fiber type has occurred; instead, you have reactivated previously atrophied fast twitch fibers.

When tested, it turned out that Hatfield's quadriceps strength was very low, while his endurance was far higher than average. He was stunned by the results and insisted upon being retested the following day; but I told him … "Fred, if twenty years of hard training hasn't done it, then twenty-four hours won't do it either." And of course, it did not; when retested the following day his results were almost identical.

The above chart shows a comparison of three subjects with different types of muscle fibers; the lowest curve shows Hatfield's level of fresh strength (below average), while the highest curve shows the fresh strength of the strongest man we ever tested (the strongest among many thousands that we have tested, among them many of the strongest men in the world), and the middle curve shows the fresh strength of a subject with a usual mixture of fiber types in his quadriceps muscles.

The strongest man has a very high percentage of fast twitch fibers, while Hatfield appears to have only slow twitch fibers in his quadriceps muscles.

So here we have a champion power lifter who actually is below average strength in his quad muscles; how, then, was it possible for him to set a record in the squat? Because the squat is not a test of quadriceps strength; squatting strength is primarily a result in the strength of the muscles of the buttocks, with help from the hamstring and lower-back muscles. And, in Hatfield's case, his squatting strength is helped by the fact that he is very short, and thus does not have to lift the weight very far. When here he weighed more than 260 pounds at a height below five feet and six inches.

It should also be mentioned that fiber type is not consistent throughout your body, you may have primarily fast twitch fibers in one muscle and only slow twitch fibers in another muscle. It does not appear that anybody has only fast twitch fibers in any muscle, they will always have at least some slow twitch fibers; but it does appear that some people have only slow twitch fibers in some muscles.

Knowing your fiber type is important, because a training routine that is ideal for a slow twitch muscle can be utterly devastating for a fast twitch muscle. Fast twitch muscles cannot tolerate either high-repetition exercise or frequent exercise, will lose strength and size if exercised in that fashion, are readily subject to overuse atrophy.

So, just how can you determine the fiber type of your muscles? In some cases you can, and in some you cannot. Since fiber type is not consistent throughout the body, you can determine fiber type only when it is possible to test and exercise a muscle in a totally isolated fashion; which means that a movement such as the bench press, or the leg press, is worthless for this purpose, because both movements are produced by several different muscles working together.

Hatfield is probably very strong in the leg press, a result of strong hip and hamstring muscles; and thus if he was tested in this fashion it would probably appear that his quadriceps muscles were very strong, while in fact they are very weak.

Most exercises involve compound movements, which means that several different muscles are involved; in a bench press you are using your triceps, your biceps, your pectorals, your deltoids and several other muscles. Thus it is impossible to determine just how much force is being produced by any one of the several muscles that are involved.

With a barbell it is possible to perform meaningful test with only a few muscles, the biceps, the triceps, the calves and the muscles that bend your hands. First you must carefully determine just how much weight you can use for only one repetition during a full-range movement; and this can be determined only by a trial and error, but do not perform more than one test during the same workout. On Monday, for example, you might be able to perform three repetitions with 100 pounds, which would mean that the weight was too light; but do not perform another test that same day; instead, during the next workout test your ability with 105 pounds, and if you can perform two or more repetitions the weight is still to light; then during the third workout test with 110 pounds, and if you find that you can perform only one repetition, fail trying a second repetition, then you know the level of your maximum strength in the movement.

Having determined your maximum level of fresh strength, then wait until the next workout and select a weight level that is 80 percent of your fresh strength in that movement, and then perform as many repetitions as you can with the weight; but all repetitions must be performed properly, which means slowly. Do not throw the weight, do not jerk, move smoothly and fairly slowly, and stop when it becomes impossible to perform another full-range movement without jerking or swinging the weight.

If you fail after about ten repetitions this means that you have a usual mixture of fibers in that muscle; but if you fail after only two or three repetitions this means that you have a high percentage of fast twitch fibers; and if you can perform twenty or more repetitions this means you have a high percentage of slow twitch fibers.

And just what does this tell us? Properly applied, this knowledge tells us how to train; and, of even greater importance, it tells us what to avoid. If you have a usual mixture of fiber types, then you should exercise with a weight that will permit at least seven but not more than ten repetitions; fast twitch muscles should use a weight that will permit at least four but not more than seven repetitions; slow twitch muscles should perform at least fifteen but not more than twenty repetitions.

How many sets of each exercise? One; additional sets will seldom if ever produce better results, and many people cannot tolerate more than one set. How many weekly workouts? Not more than two, and some people will produce better results from only one weekly workout. More is not always better, and in the case of exercise is usually worse. When properly performed (totally isolated) exercise for the muscles that extend the lumbar spine is used, we have found that best results are usually produced by only one exercise every 14 days, and that such exercise should never be performed more often than once each week.

Once it finally became possible to meaningfully test and properly exercise the muscles that extend the lumbar spine, we discovered that practically everybody on the planet is suffering from disuse atrophy of these important muscles; and this proved to be true even with subjects that had been training for years and were far above average strength in most of their muscles. The first five subjects who were tested and exercised with this machine produced the following results; ONE, an increase strength in the fully-extended position of 180 percent within a period of ten weeks, as a result of only ten exercises; TWO, an increase in the same position of 450 percent within a period of five months and eight days, as a result of exercise preformed only once each 14 days; THREE, an increase of 877 percent within 27 weeks from exercise performed once each 14 days; FOUR, an increase of 1,470 percent within a period of 76 days from exercise performed each 14 days; Five, an increase of 7,300 percent within six months from exercise every 14 days (this man's strength, in that position, increased from 4 foot-pounds of maximum torque to a level of 296 foot-pounds).

Increases in strength that are simply impossible, in any length of time… impossible, at least, with a normal muscle; but not impossible for an atrophied muscle. Just how much you can increase your strength is largely determined by your starting level of strength; all of these men showed the effects of chronic disuse atrophy, and four out of these five subjects had been using a Nautilus Lower-back machine on a regular basis for a period of several years, were very

strong on that machine; but, in fact, it turned out that their lower-back muscles were actually weak. Exercise on the Nautilus machines had increased the strength of their hip and thigh muscles while doing absolutely nothing for the muscles of their lower backs. The machine (invented by me) is misnamed, should be called a hip and thigh machine. When I invented that machine I believed that it provided meaningful exercise for the muscles of the lower back, but it turned out that I was wrong.

Which is only one of several thousand mistakes I have made; but primarily, that is how you learn, from your mistakes. If you are lucky enough to notice them, and honest enough to admit them. When something fails, it should get your attention, and that should lead to a careful examination of the situation, which sometimes leads to a solution; but when something appears to work, then you believe you already know that answer and quit looking; which is usually a mistake, because even when something appears to work we usually give the credit to the wrong factor, seldom really understand the actual cause and effect relationship.

And just what, you may be asking yourself, does all of this have to do with the theme of this article, The Myth of Isokinetics? Not to worry, we are getting there.

Everything stated above was mentioned in an attempt to explain the fact that meaningful tests of strength are not as simple as many people believe; it took me fifty years and more than eight million dollars of my own money to figure out how to do it.

If perhaps not quite impossible, direct measurement of strength is certainly not practical; to measure strength directly you would have to cut the tendon that attached the muscle to a bone and then insert a stain gauge (force measuring device) between the ends of the cut tendon, and then have the subject produce the highest possible level of force from muscular contraction. But having done so you would have destroyed the muscle you were trying to test. So this procedure leaves a great deal to be desired.

Thus we must measure strength indirectly; we must measure the output of torque (force around an axis of rotation), and in order to measure torque we must know several things; we must be able to locate the axis of rotation of the joint that is involved, and then we must know the exact distance from the axis to the point where force is measured.

And that turned out to be the easy part; much harder parts followed, many factors that were not anticipated because obvious as time passed; problems that had to be solved by trial and error. Over a period of more that twenty years we designed, built, and rejected more than 4,000 prototype machines; rejected them because they did not work, could not produce meaningful measurements of strength.

But, throughout that same period, first Cybex and later several other companies started selling so-called testing machines that can not provide any of their intended functions. Which places these machines somewhere between outright fraud and criminal malpractice. Such machines are based upon so-called isokinetic sources of resistance; the name being intended to mean “same speed.” But even the name was false; the original Cybex machines did not in fact provide a constant speed of movement; instead, the actual speed of movement varied both above and below the selected speed of movement, varied by several hundred percent.

And such variation in the speed of movement produced high levels of impact force, which is dangerous as hell.

They measured these high levels of impact force, called them torque (which are not), then ran the results through a so-called “damping” device (an electronic lying machine), and then presented you with results that had absolutely nothing to do with anything.

Which makes just as much sense as trying to weigh yourself by jumping up and down on a scale; while in the air you will weigh nothing, but when you come back down the scale may record a force of over a thousand pounds; so which is your weight, zero or 1,000 pounds?

In some of their ads Cybex claims that more than 700 scientific studies have been performed using their equipment; and if true then this may be the only true statement ever made by Cybex. But just what has been discovered as a result of all this research? Not a damned thing. Zilch. Zero. Nada. Izeko (which is Zulu in case you are illiterate).

Which does not mean that nothing was "proven" by all this research; quite the contrary, they clearly proved the ignorance of all the people involved in any such research. After all, who but the ignorant would perform research with a tool that is utterly worthless for its intended purposes?

In addition to the fact that they were not in fact measuring torque, they also failed to provide the isolation that is required in order to know just which muscles is being tested; and they utterly ignored the effects of gravity, the effects of friction, and the effects of stored energy, all of which factors must be considered in order to provide a meaningful test of strength.

Are all of the people in the scientific community really that dumb? Well, perhaps not all of them, but certainly most of them. I used to believe that bodybuilders, as a group, were the dumbest people I had ever met; then, later, having worked with a large numbers of them, I realized that coaches, as a group, are even dumber than bodybuilders; then, later yet, I worked with large numbers of scientists, and was finally forced to realized that they are even dumber, as a group, then coaches; most recently, I have been involved with large numbers of physical therapists, and don't yet know just which group is the dumbest, the scientists or the therapists.

All of the factors I have mentioned above, the need for total isolation of the joint being tested, the effects of gravity, the effects of friction, the effects of stored energy, and so on, are not subject to differences of opinion; all of these factors can be clearly demonstrated, and all of them are established by very simple laws of basic physics. Yet, in general, the scientific community continues to ignore all of them as if they did not exist; in the meantime considering themselves to be "experts."

Meaningful testing of strength requires total isolation of the joint being tested, requires careful counterweighting in order to remove the effects of gravity, requires a static (isometric) testing procedure to remove the effects of friction, requires the measurement of torque produced by stored energy so that it can be factored into the test results, and requires an accurate measurement of the relative positions of the body parts involved in the test, such positional measurements being required because changes in position produce changes in strength; until all of these requirements are provided, any attempt to measure strength is an exercise in futility at best.

Yet our competitors, and people dumb enough to use their products, continue to ignore all of these factors. At least they are consistent: everything they do is wrong.

And no end is in sight; it just gets wider and deeper. The most recently coined "buzzwords" in this field are "open chain" and "closed chain." One being perfect, of course, and the other being evil. A compound movement such as a bench press or leg press is called "closed chain," and this is suppose to be good; while an isolated, single axis movement like the leg-extension exercise is called an "open chain" movement, and that is suppose to be bad, evil, dangerous, to be avoided like the plague.

One company recently introduced a testing machine based upon a "closed chain:" movement, the leg press; and while it is certainly possible to measure the force produced during a leg press, it is utterly impossible to determine just where that force came from. Three distinct muscles are involved in the leg press, the quadriceps, the hamstrings, and the large muscles of the buttocks. Any such testing is worthless for any purpose. But I promise you, count on it, you will hear a lot more about the supposed advantages of "closed chain" movements, as well as a lot more about the dangers of "open chain" movements.

Which is certainly not intended to imply that I am against so-called "closed chain" (compound) exercises; such exercises certainly have very real value, but they are worthless for testing purposes.

It also happens that several important muscles can be exercised meaningfully only with so-called "open chain" (single axis) movements. We have clearly established that the important muscles of the lower back will respond only to isolated exercise, and it is also obvious that the muscles of the neck and the muscles of the forearms and calves can be exercised meaningfully only with single axis movements.

Yet another company, Isotechnologies, is selling a machine called a B 200, which is based upon so-called "isoinertial" source of resistance, which supposedly supplies a constant level of resistance instead of a constant speed of movement, and then strength is supposedly determined by measuring the speed of movement; all of which, of course, is hogwash, such machines have all of the same problems found in isokinetic machines plus a few other problems that are unique. Isolation is not provided, gravity, friction and stored energy are all ignored, and the possible range of movement of the machine is far less than a normal full range of movement.

Such machines cost nearly $70,000.00 and hundreds of them have been sold to people who should have known better, but obviously did not know better; one major medical company bought nearly thirty of these machines, to their largest regret. These machines are now standing unused, gathering dust, while being replaced by our machines. But that is an exception, not the rule; most people, having made such a mistake, can never bring themselves to admit that it was a mistake, will continue to do something even after they know it is wrong.

Buying the machines in the first place was proof of their ignorance, but ignorance is common to us all, ignorance is simply a lack of knowledge and that can be corrected; but continuing to use something after having discovered that it is worthless (and dangerous) is not ignorance, that is stupidity and cannot be corrected. We are all ignorant, but we are not all stupid.

At least two of the doctors now using our equipment with thousands of chronic lower-back pain patients, with outstanding clinical results, were at one time ignorant enough (uniformed enough) to use Cybex equipment; but they were not stupid, they eventually recognized their earlier mistakes and freely admitted them. Which is a sign of both intelligence and honesty. Both of which factors are rare.

During the sixteen years that I was directing Nautilus I published a total of more than one hundred articles in various magazines and journals, and I was sometimes accused of writing articles in an attempt to sell my products; and I certainly was interested in selling my products, but that was not the purpose of my articles, and most of those articles had little or nothing to do with Nautilus machines. Instead, those articles were primarily devoted to the basics of exercise with any tool. And, at the moment, I am not trying to sell you anything; our current products are primarily intended for very specialized clinical use, are far too complicated and much too expensive for general use.

But mention of the functions of our equipment is required in order to make clear many of the points that I am trying to establish; many of these things being factors that were not even suspected as recently as seven years ago, things that could not have been discovered earlier, could not have been discovered because there was then no tool that was capable of measuring strength in a meaningful fashion, things that we did not anticipate, but things that we could not fail to notice after they were clearly demonstrated.

We do not claim to have all of the answers, are probably not even aware of all of the possible questions, but we do at least have some important answers, and we are so far ahead of whoever is in second place that they cannot even see the dust from our heels.

By the end of this series of articles, you will have been provided with all of the current knowledge in the field; not "part of it," but rather "all of it." There are many points that must be covered, and when viewed altogether it sometimes tends to intimidate people, they may feel that it is simply too complicated for them to understand. But in fact, when looked at one by one, all of these points are actually quire simple and can be clearly understood and properly applied by almost anybody.