# The Future of Exercise

# (1997 and Beyond)

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# The Actual Requirements for Proper Exercise

Some part of the brain continuously monitors both your current activities and the metabolic requirements for the performance of these activities. Having done so, then an unconscious decision is made: the body, basing its decisions upon previous activities, decides just what changes, if any, are required for future activities. If you are already working near the absolute limit of your ability, the body will probably decide that you need to be stronger, and will then produce the changes that are required to make you stronger. Then, if you do not do something that will prevent these increases in strength, you will become stronger. Will increase your muscular strength, muscular endurance or cardiovascular ability; at least some of which changes will also increase your structural strength, thereby making you less likely to suffer the consequences of an injury.

In addition to increasing the strength and size of your muscles, proper exercise will also increase both the functional and structural strength of your bones, tendons, ligaments, heart and other organs; thereby providing both improved functional ability and protection from injury.

None of which improvements, as stated earlier, are actually “produced” by exercise, but are, instead, “stimulated” by exercise.

I devoted years of thought and effort in an attempt to develop exercise machines that were capable of providing truly full-range exercise. Why? Because it was obvious to me, if perhaps still unsuspected by most other people, that truly full-range exercises would lead to better results from exercise. All of a muscle is not involved throughout a large part of the range of movement provided by almost all conventional exercises. Thus such exercises stimulate only part of a muscle, leaving other parts of the same muscle unstimulated.

In a so-called “curling” exercise performed with a barbell, full-range resistance against the movement is not provided; there is literally no resistance provided in either the starting or finishing positions of the movement, resistance is provided only in the midrange of movement, and a barbell cannot provide resistance in other positions.

With the application of a bit of common sense, it is easily possible to establish the full range of movement that is provided by almost any of your muscles: FIRST, move into various positions until you discover the position that results in the longest-possible length of the muscle; SECOND, then determine the position that produces the shortest-possible length of the muscle. In the case of the muscles on the front of the upper arms, the longest length will be found only when your arms are “straight,” are not bent around the axis of the elbow joints, while the hands are twisted into the fully pronated position and the elbows are as far as possible behind the midline of the spine.

Then, in order to provide full contraction of these muscles, you must end the movement in a position where your arms are bent as far as possible around the axis of the elbow joints, while the hands are twisted as far as possible in the direction of supination and the elbows are moved into a position directly behind your head. That proper ending position is the only position in which it is possible to provide full contraction of the muscles. Without which full contraction against resistance you will be exercising only part of the muscles.

Your biceps muscles provide three distinct functions: they bend the arms around the axis of the elbow joints, but they also twist your forearms and hands in the direction of supination, and help you to raise your elbows as far as possible above the level of your shoulders. If you would like to experience, probably for the first time in your life, just what full contraction of the biceps muscles feels like, bend your arm as far as possible, then twist your hand as far as possible in the direction of supination, and then elevate your elbow as far as possible above the shoulder joint, and in that position contract the biceps muscles as hard as possible. If you have never tried this before, it will probably be somewhat painful, the biceps muscle will probably start cramping. But remember, that is the only position that provides you with the ability to involve all of the muscle in the exercise.

"And just what," you might be wondering, "is supination?" You are supinating your hand when you twist it, in the case of the right hand, in a clockwise direction; or in a counterclockwise direction in the case of your left hand. Pronation occurs when you twist your hand in an opposite direction, clockwise for the left hand and counterclockwise with the right hand.

The muscular force required to supinate the hand is produced primarily by the biceps muscles; supination of the hand, in fact, being the primary function of the biceps muscles; both bending the arm around the axis of the elbow and raising the elbow above the shoulder joint are secondary functions of the biceps muscle.

Which leads directly to the next point: just why do we have thumbs on our hands, and why are they located on the tops of the hands? You can do many things with your thumbs, hit them with a hammer, use them for hitch hiking, wipe your eyes with them, and many other things; but do you really believe that such uses explain why we have thumbs?

It is almost universally believed that the thumb's primary function is to help us to grip things, and they do assist gripping, but that is, at best, a secondary function. The primary function of the thumb is to serve as an anchor for the hand while performing supination movements. And that explains why our thumbs are located on the top of our hands; because, if the thumbs were located either in the middle or the bottom of our hands, they then could not anchor the hand very well, if at all, during movements that involve supination.

You can, in fact, supinate your hand as hard as possible without using the fingers at all; your thumb, acting together with the lower side of the palm of your hand, will anchor your hand as solidly as possible during movements that involve supination.

If the thumb had been intended primarily to aid in gripping, then it would not have been located on the top of your hand; instead, it would have been located in the middle of your hand, directly opposed to your fingers, as is usually the case with animals that depend upon their gripping strength for their survival, animals such as crabs and lobsters.

At least two types of animals that do depend upon their gripping strength for their survival, spider monkeys and sloths, do not even have thumbs; which should not be surprising, since they have very little in the way of biceps muscles, and thus do not need thumbs.

In an attempt to determine the intended function of a muscle, do not concern yourself at all with things that you can do with the muscle; instead, look carefully for things that you cannot do without that muscle. Having determined that, then you will understand just why muscles were provided.

Why do we need a supersonic airplane? Because, without it, we cannot fly faster than the speed of sound. And the same rule applies to muscles or just about anything else you can think of.

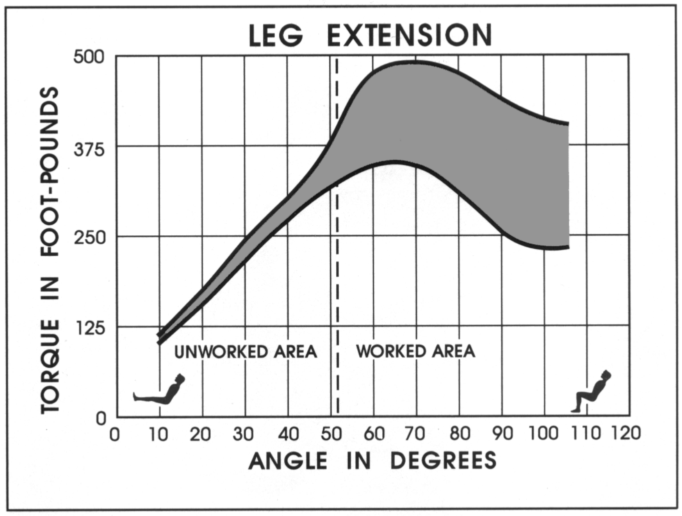
Most people have been brainwashed into believing that the human brain developed to its current level as a result of our thumbs, supposedly "opposable" thumbs that made it possible to use tools, and that the use of tools stimulated increases in the ability of our brains. Well, as it happens, we do not have opposable thumbs; thus another myth bites the dust.

Many people have been trying, so far without any slightest degree of success until we came along, to measure the true range of movement of the lumbar spine; fairly recently, a supposedly scientific article was published in SPINE, one of the most respected scientific journals, an article that stated that "normal" ranges of movement of the lumbar spine were somewhat more than 90 degrees during movements from the starting, flexed, position to the ending, extended, position of the spine. Really? Well, show me somebody with that range of lumbar-spinal movement and I will show you a corpse; normal range is usually no more than 72 degrees, and is frequently less than that. You would have to break a subject's back in order to produce 90 degrees of movement in that plane.

The same article stated that longitudinal rotation of the lumbar spine was usually about 70 degrees; when, in fact, there is no movement in that plane in the lumbar spine. The design of the facets of the lumbar spine prevents any such movement.

The normal range of movement during torso rotation is 120 degrees, but none of that movement occurs in the lumbar spine; all of that movement occurs above the so-called, but misnamed, T 11; below that part of the spine, no such movement is possible, literally none.

fig. 1




Whoever decided that we have 12 thoracic vertebrae and 5 lumbar vertebrae had his head in the sand; either never bothered to look at a skeleton or did not understand it if he did. In fact, we have only 10 thoracic vertebrae and 7 lumbar vertebrae. Remember, "function dictates design," or "form follows function," while the misnamed T 11 and T 12 do have "floating " ribs, while the rest of the spine below T 12 does not, that is irrelevant. Look, instead, at the facets of T11 and T12; which are identical to the facets of the lumbar-spinal part of the spine. Are designed to prevent longitudinal rotation, would be broken off if any such rotation occurred in that part of the spine.

The author of the article mentioned above obviously did not use testing tools that permitted him to distinguish between spinal movement and pelvic movement; yet his article was accepted for publication in a supposedly scientific journal, and I am sure his totally mistaken statements were widely believed throughout the medical community.

One testing tool that was widely used until quite recently, and is probably still being used by many people, the so-called B-200, supposedly is capable of measuring torso rotation. Which is interesting, to say the least, because the normal range of torso rotation, with no slightest degree of rotation of the pelvis, is 120 degrees, but the B-200 provides only 90 degrees of movement in that plane.

Nevertheless, some people who were dumb enough to use such an utterly worthless testing tool supposedly performed research with it, wrote up their claimed results, got them published in a scientific journal edited by obvious idiots, and then were awarded the so-called "Volvo Award" for "significant contributions to the field of spinal knowledge."

A second article published in SPINE, an article that supposedly stated normal ranges of spinal movement, was based upon tests conducted with a B-200, and their statements were also utterly wrong, literally impossible. But, again, apparently nobody rejected these stupid statements. Nobody except me.

A few weeks ago, during a medical symposium in San Diego, I spoke at rather great length with the man who invented the B-200, but was unable to make him understand that what he was trying to do was simply impossible. He believes that one machine can be designed that will accurately measure both strength and ranges of movement in any direction, flexion/extension, longitudinal rotation, and lateral flexion (bending the spine to the side).

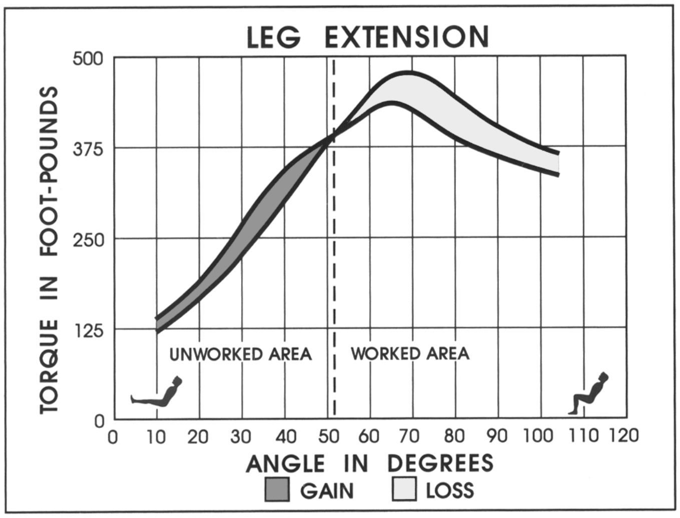
And, of course, he insists upon using a dynamic testing procedure.

Like many other people, once having made up his mind, he simply refuses to admit his own mistakes. Fortunately, the B-200 is no longer on the market. The inventor of the B-200 blames me for putting his company out of business, which, if true, represents a feather in my hat rather than egg on my face.

Following illustrations should go a long way in the direction of establishing the need for truly full-range exercise. About ten years ago, we conducted long-range research with several hundred subjects in order to determine their responses to limited-range exercise; the following charts show the results produced by only one of these subjects, but they were typical results for most of the group.

Figure 1 shows the strength increases that were produced in the quadriceps muscles of this subject; the lowest strength curve shown on the chart illustrates the fresh level of strength of his quadriceps muscles at the start of this research program, while the much higher strength curve shows his strength about eighteen weeks later. The gray area between the two curves represents gains in strength.

fig. 2




Provided largely, but not entirely, with limited - range exercise, work primarily in the first half of full-range movement, this subject increased his quadriceps strength to an enormous degree in the worked range of movement; as a result of only seventeen exercises during a period of more than eighteen weeks, less than one exercise each week. In the range of movement that we called the unworked area, his gains in strength were much lower, an average of only 13 percent in the unworked area, compared to an average of more than 60 percent in the worked area, with gains of more than 80 percent in some positions within the worked area.

But some work was performed in the unworked area during that period; of the total of seventeen exercise sessions, one provided exercise in the last part of the range, one involved work only in the midrange of possible movement, and one involved a full range of movement, and, additionally, repeated static testing was performed throughout a full range of movement, which provided some exercise in the unworked area. Nevertheless, the results were largely limited to the worked area, a very distinct response to limited-range exercise, gains in the worked area with little or no gains in the unworked area.

Following the results shown above, several weeks of continued exercise performed once each week failed to produce any additional gain in strength; whereupon, we started exercising him twice each week to see if more frequent exercise was required. But several months of twice weekly exercise produced no change in strength. Having discovered that more frequent exercise was not the solution, we then changed to limited-range exercise only in the last half of the full range of movement, avoided any exercise in the previously worked area. Five weeks of exercise in the previously unworked range produced the following results.

Exercised once each week for five weeks in the previously unworked, last half of a full-range movement, he immediately started to increase his strength in the last half of the movement range, while losing strength in the first half of the range; gains in one part of the movement range with simultaneous losses of strength in another part of the range. The dark gray area shows losses in strength, while the light gray area shows gains. (fig. 2)

The requirement for truly full-range exercise should be clearly established by the above illustrations, but you should also understand that there are at least some exceptions to this general rule. During the course of research programs that were conducted with hundreds of subjects, we discovered that there are some people who respond to limited-range exercise differently, do not produce the results that we expected. Approximately 80 percent of a random group of people will respond to limited-range exercise by producing limited-range increases in strength; but about 20 percent of the group will respond differently. They will produce full-range increases in strength even when exercised with limited-range movements.

Such subjects will not produce proportionate strength increases in the unworked range of movement, but will, at least, produce some strength increases in the unworked part of a full range of possible movement.

So we divided the overall group of subjects into two subgroups: people who respond to limited-range exercise by producing limited-range increases in strength were then called “Type S” subjects, S for “specific,” while people who produced at least some strength increases throughout a full range of possible movement even when exercised with limited-range movements we called “Type G” subjects, G for general.

But such exceptions to the general rule do not disprove the requirement for full-range exercise, because even Type G subjects will respond to full-range exercise better than they will to limited-range exercise.

I cannot explain just why these two subgroups of subjects respond differently to limited-range exercise; perhaps there are physiological differences that cannot yet be explained, so I am aware of the differences but do not understand them. But such differences do not appear to be a result of differences in muscular fiber type, since we found subjects with a very high percentage of fast-twitch muscle fibers who were obviously Type S subjects, while other people with the same type of muscle fibers were just as obviously Type G subjects.

fig. 3

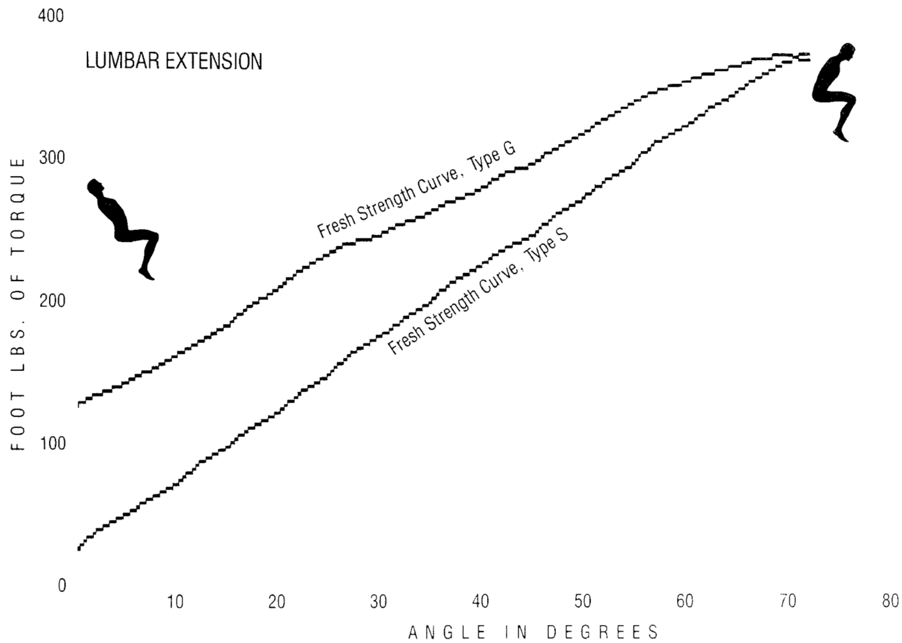



Figure 3 shows a comparison of the full-range, totally-isolated, fresh strength levels of two subjects when they were initially tested for the strength of the muscles that extend the lumbar spine. One of these men was a Type G subject, and his strength is shown by the highest of the two curves; the other man was a Type S subject, his strength shown by the lowest curve. Their strength was almost identical in the flexed position, shown on the right side of the chart, the Type G subject produced 372 foot-pounds of torque in that position, while the Type S man produced 369 foot-pounds in the same position.

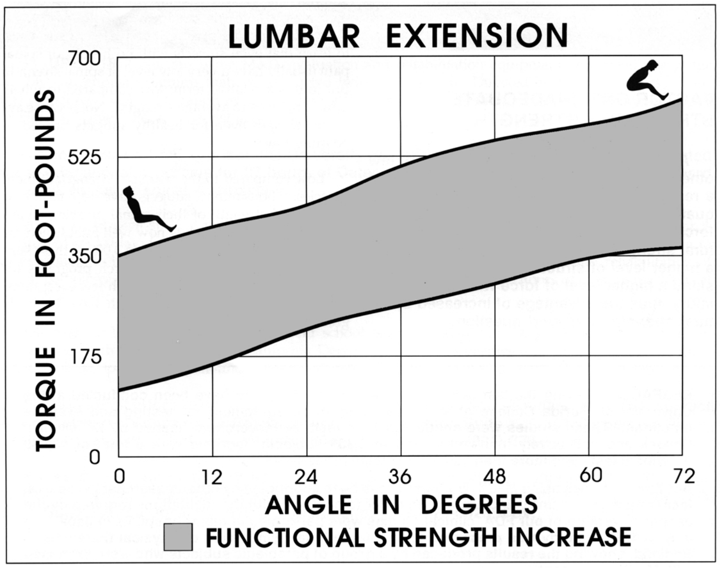
But as they moved through a full range of possible movement, the Type S subject's strength fell off much more rapidly than it did with the Type G subject; in the fully-extended position he could produce only 26 foot-pounds of torque, while the Type G man, in the same position, was nearly five times as strong as he was, produced 125 foot-pounds of torque when fully extended.

Both were male subjects of similar age and size, mid-twenties and about 190 pounds at a height of near six feet. Both were very cooperative and the tests were accurate. Neither of these men had a proportionate level of strength in the extended position, but the Type G man produced about 40 percent of an appropriate level of strength in the extended position while the Type S subject produced less than 10 of an appropriate level of strength in that position. A test of peak strength would have made it appear that these two subjects were almost perfectly equal, but in fact they were far from equal in any meaningful sense.

Both of these subjects were exercised to a point of momentary failure immediately after the tests of fresh strength were performed, using levels of resistance that we considered appropriate based upon their demonstrated levels of fresh strength. The Type G subject was able to perform nine full-range repetitions while using resistance of 200 foot-pounds; and then, when his remaining level of strength was tested immediately after the exercise, we found that the exercise had reduced his fresh strength by approximately 20 percent.

In stark contrast, the Type S subject could not perform even one full-range repetition against resistance of only 150 foot-pounds. Using resistance that was only 75 percent of that used by the Type G subject he could perform less than half of a full range of movement towards the extended position and then was forced to stop.

fig. 4




When it became obvious that the initially-selected level of resistance was far too high for this subject, we reduced the resistance to 100 foot-pounds, only half as much resistance as the Type G subject used. Then, with the lower level of resistance, he could perform full range exercise.

Following the exercise, his remaining level of strength was tested in order to determine just how much his fresh level of strength had been reduced by the exercise. In the flexed position the exercise reduced his fresh strength by 28.7 percent, but in the fully-extended position he then could not produce a measurable level of torque, could not produce even one tenth of one foot-pound of torque.

The Type S subject involved in these testing procedures was a physical therapist from Philadelphia who had been performing regular exercise for several years using a Cybex copy of the Nautilus Lower-back machine, exercise that obviously did nothing for the strength of his lower-back muscles. The Type G subject had been using a Nautilus Lower-back machine for several years, and while he was much stronger than the Type S subject in most positions this greater strength was not produced by the Nautilus machine; a statement that is clearly established in figure 4.

Exercised once a week for a period of only ten weeks, using a MedX Lumbar-extension machine, the Type G subject mentioned above increased his lower-back strength to an enormous degree. During his eleventh exercise he performed nine repetitions with 400 foot-pounds of resistance, the same number of repetitions performed during his initial testing procedure but with twice as much resistance; so his full-range dynamic strength had been increased by 100 percent as a result of only ten exercises. Based upon the areas under the two strength curves, his overall strength had been increased by more than 91 percent, while his strength in the flexed position was up by more than 68 percent and his strength in the extended position was up by exactly 180 percent.

Such a magnitude of strength increase is simply impossible with a “normal” muscle, and such a rate of increase is equally impossible with a normal muscle; can be explained only if we assume that his muscles were not normal at the start; instead, he had started with muscles showing the effects of chronic disuse atrophy, a low level of strength that existed in spite of his previous exercise with the Nautilus machine.

The other man, the Type S subject, returned to Philadelphia after a brief visit to Florida, so we were never able to test or exercise him again; but given his initial very low level of strength in the extended position, I am absolutely certain that we could have increased his strength in the extended position by at least 1,000 percent as a result of only ten exercises performed over a period of ten weeks. I can be certain of that possibility because we have subsequently produced even better results than that with hundreds of other subjects. One subject increased his strength in the extended position from an initial level of only 4 foot-pounds to a later level of 296 foot-pounds, an increase in strength of 7,300 percent.

So far, since we first became aware of these differences, I have never found any mention of them that was published by anybody else working in the field of exercise physiology; so it appears that the scientific community as a whole still remains unaware of such differences. And if the responses that I have experienced when I mentioned these differences to a scientist in this field mean anything, they probably would try to deny them even if they did become aware of them. Apparently the NIH factor, “not invented here,” again raises its ugly head.

In fact, during the last couple of years, a large part of the scientific community has made firm steps in the wrong direction: so we now have a lot of physical therapists who are almost violently opposed to full-range exercise of any kind while endorsing limited-range exercise. They do not, of course, call them "full range" or "limited range" exercises, and obviously do not understand the differences; instead, they recently started calling them "open chain" and "closed chain" exercises, when they should have called them "isolated" exercises and "compound" exercises. Isolated exercises are produced when the involved body parts rotate around the axis of one joint, exercises such as a curling movement for the muscles of your upper arms, or leg-extension movements for your quadriceps muscles. Compound exercises, in stark contrast, involve movements that produce rotation of the involved body parts around more than one joint axis, exercises such as leg presses, squats or bench presses. By the very nature of things, compound movements cannot provide full-range exercise; and, secondly, compound movements involve several different muscles, which makes it impossible to determine just which muscles are becoming stronger even when strength increases are produced.

fig. 5

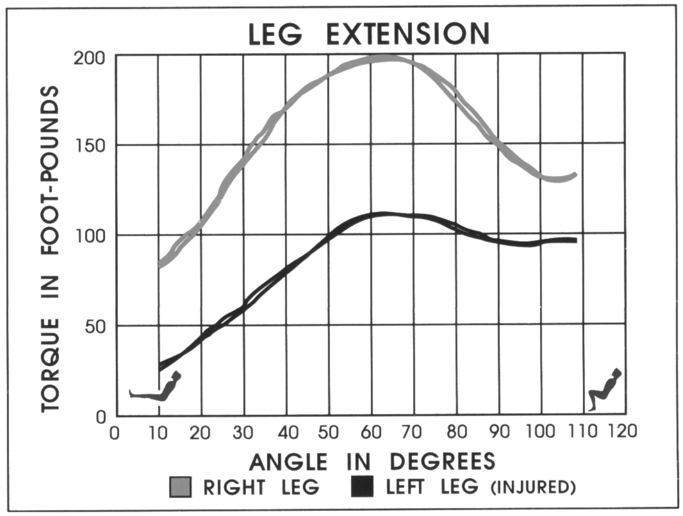
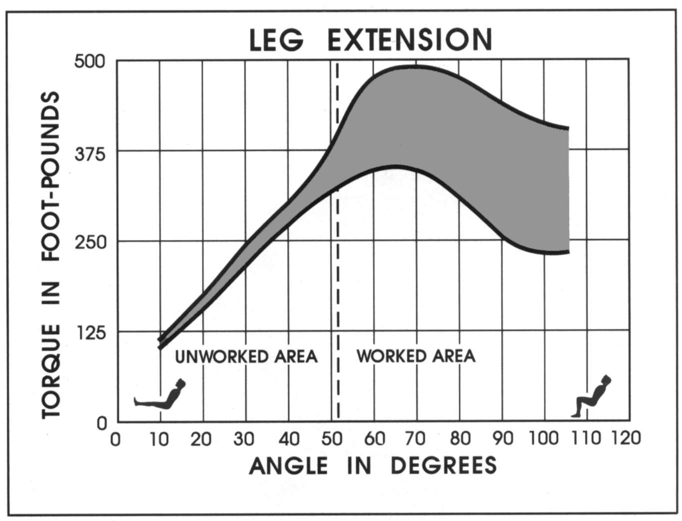



fig. 6




At the moment, many physical therapists avoid leg-extension exercises like the plague, wrongly convinced that such exercises are dangerous, while using compound movements that cannot produce full-range strength increases. When, in fact, leg-extension movements provide the only source of full-range exercise for the quadriceps muscles; and, are, in addition, far safer then any compound exercise for these muscles.

About ten years ago, Joe Cirulli, who operates one of the most successful health clubs in the world, in Gainesville, Florida, as well as a rehabilitation clinic utilizing MedX equipment exclusively, injured his knee and then had surgery. A few weeks after his surgery, we tested the full-range level of his strength in both legs; test results that are illustrated by the following chart. Both legs were tested twice, so we have two strength curves for both legs, the good leg and the injured leg; and, as you can see by looking at the chart, the test results were almost identical during each of the two tests.

Figure 5: Based upon the areas under the strength curves, the overall loss of fresh strength in the injured leg, which loss of strength resulted from disuse atrophy that resulted from several weeks during which no exercise was performed, a few weeks after surgery, the loss of strength was about 50 percent; but in some positions it was greater than 50 percent; near full extension of the leg, the loss of strength was exactly 72 percent.

Immediately after the second of these two strength tests were performed, Joe started a program of rehabilitative exercise, using leg-extension exercise; but the physical therapist who was directing his rehabilitation refused to let him perform full-range exercise, limited his exercise to about one third of a full-range movement, would not let him perform any exercise in the last two-thirds of a full-range movement ending in the fully-extended position.

After a few weeks of such limited-range exercise, we tested the strength of the injured leg again, producing the test results shown in figure 6. Joe had then restored all of his lost strength in the range of movement where he had been exercised, while producing much less in the way of strength increases in the last two-thirds of a full-range movement.

Having seen the poor results that resulted from following the advice of the physical therapist, Joe told him to "take a hike," and afterwards directed his own program of rehabilitative exercise, immediately started performing full-range leg-extension exercise. And when we tested his injured leg again a few weeks later, we found that he had restored all of his lost strength throughout a full range of possible movement; in fact, at that point, his injured leg was actually somewhat stronger than his good leg.

Most physical therapists are wrongly convinced that leg-extension movements performed near a position of full extension of the leg impose very high, and thus dangerous, levels of force on the knee. When, in fact, leg-extension exercises impose no force on the knee in the fully-extended position, literally none. If you understand the laws of physics as they apply to a block and tackle, which most physical therapists obviously do not, then you would understand that the same rules apply to the knee; the forces imposed upon the knee are highest when the leg is fully bent around the axis of the knee, but then rapidly fall off as you straighten the leg. Nevertheless, they continue to exercise people in places where the force on the knee is highest, while avoiding exercise in places where there is no force on the knee.

And, in many cases, they avoid leg-extension exercises entirely; instead use compound exercises like the leg press, even though such exercise cannot produce full-range increases in the strength of the quadriceps muscles.

The need for full-range exercise should be established by the preceding examples; but full-range exercise is only one of nine basic requirements for proper exercise. I will cover the remaining eight requirements in later chapters.