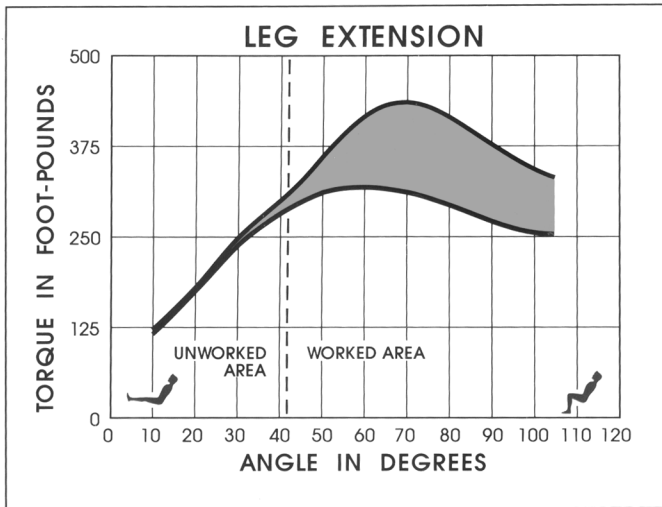


# My First Half-Century in the Iron Game

# 12

The latest buzz-words in the field of exercise are “Closed Chain” and “Open Chain,” one supposedly being perfect and the other being evil. A Closed Chain exercise is a compound movement such as the leg press or bench press, where several joints are involved in the movement; while an Open Chain exercise is a movement where only one joint is involved, exercises such as the leg extension or leg curl and a long list of others.



A few self-proclaimed “experts” are now beating the drums in favor of Closed Chain exercise while knocking Open Chain exercises, and one company recently announced a Closed Chain “testing” machine, a leg-press machine. And, yes, it is possible to measure the level of force produced in a leg-press movement; but, no, it is not possible to determine just which muscle produced that force. Muscles of the buttocks, hamstrings and quadriceps all contribute to the force produced in a leg press, and it is impossible to say just what part of the total force comes from any particular muscle. So, for testing purposes a Closed Chain movement is utterly worthless.

Which certainly does not mean that the leg-press movement, as an exercise, is worthless. Quite the contrary, many compound, “Closed Chain,” exercises are very valuable, but not for testing purposes.

About eighty percent of a random group of people display a Type S (S for Specific) response to limited-range exercise. Look carefully at the first chart.

The above chart shows two full-range tests of quadriceps strength; one of these tests was conducted with fresh muscles, and then the subject was exercised to a point of failure in a leg-extension machine; but the exercise was limited to the first half of a full-range movement; then immediately after the exercise, the subject’s remaining level of strength was tested. So we have two curves of full-range strength: fresh strength before exercise and exhausted strength following exercise.

Notice that the exhausted level of strength, shown on the right side of this chart (with bent legs), is far below the fresh level; but on the left side of the chart, showing both fresh and exhausted strength in the range of movement (near full extension) where no exercise was performed, there is no difference between the fresh and exhausted levels of strength. Fatigue from the exercise within the worked range of movement, and no fatigue in the unworked range.

In another instance we tested fresh and exhausted levels of quadriceps strength; but in this case the exercise was a leg press movement rather than leg extensions. There was an obvious difference in the levels of fresh and exhausted strength when the knees were bent; but when post-exercise strength was tested at full contraction there was no difference. And this was not a limited-range exercise; or, at least, was not intended to be; movement was started with the legs bent as much as possible and was continued until the legs were fully straight at the knees.

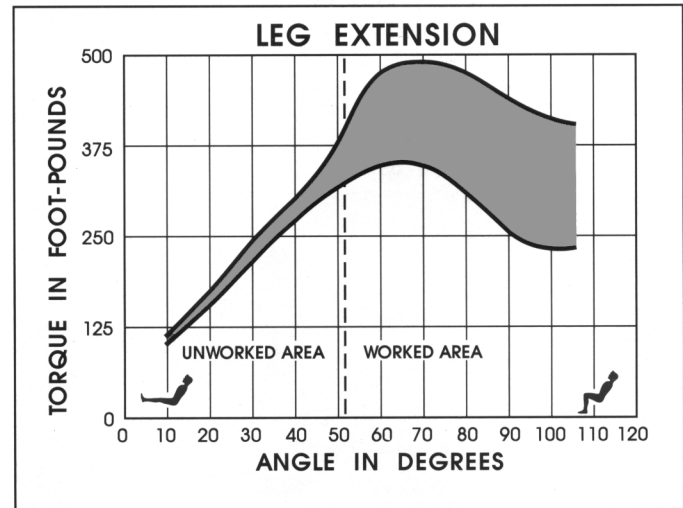
It should also be noted that this leg-press machine provided variable resistance; if the resistance was, for example, 300 pounds in the bent-legged position shown on the right side of the chart, then it was 900 pounds (three times as high) in the straight-legged position shown on the left side of the chart. So 300 pounds of resistance produced fatigue on one

end of the movement while 900 pounds produced no fatigue on the other end of the same movement.

Why Not?

Because, in a leg press (or a squat) as you move close to a straight-legged position your knees have an enormous advantage in leverage; in that part of the full-range movement no possible amount of resistance would be high enough for your muscles to even be aware of it. A level of resistance high enough to be noticed by your muscles would crush your bones.

Which means, quite simply, that the last part of a leg-press movement is worthless for any purpose; you would be well advised to avoid the last part of that movement, stop when your legs are still bent at the knees by about 15 degrees, do not “lock out.”



So, while the leg-press may appear to be a full-range exercise in fact is not; full-range exercise for the quadriceps can be provided only by leg extensions. But, according to the latest crop of self-proclaimed “experts,” leg extensions should be avoided like the plague.

And, as it happens, an important part of the quadriceps muscles is not involved throughout a full-range movement; becomes involved only in the last part of the movement range, works only near a position of full extension. Which means that the leg press provides no benefits for that part of the quadriceps muscles.

The second chart shows two curves of the fresh strength of this subject’s Quadriceps muscles; the lowest curve shows his starting level of fresh strength while the higher curve shows his fresh strength eighteen weeks later following an exercise program. The area between the two curves shows his gains in quadriceps strength. In this case, again, he performed only limited-range exercise, the first half of leg-extension movements; with no exercise in the last half of a full range of movement.

In the range that we called the “worked area” his strength increased an average of 60 percent, with a gain of more than 80 percent in one position; but in the range that we called the “unworked area” his average gain was only 13 percent.

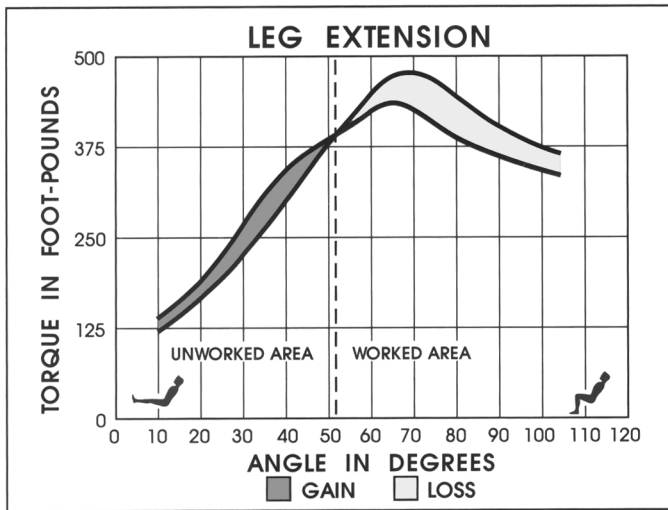
These strength increases were produced by only 17 exercises, an average of slightly less than one exercise each week.

It should also be noted that we tested his levels of fresh and exhausted full-range strength before and after each exercise session, and his testing did in fact provide some exercise in that area we are calling “unworked.” Nevertheless, gains were much greater in the worked area.

Following this 18 week session of exercise he continued to exercise once a week for another three months, but did not produce any additional gains in strength; so then we changed him to a program that involved two exercises each week, in an attempt to determine if more exercise would produce additional gains in strength. It did not, his strength remained unchanged.

So then we switched his exercise program again; went back to a schedule of only one exercise each week, and started limited-range exercise in the last half of a full-range movement rather than the first half. The following chart shows the results.

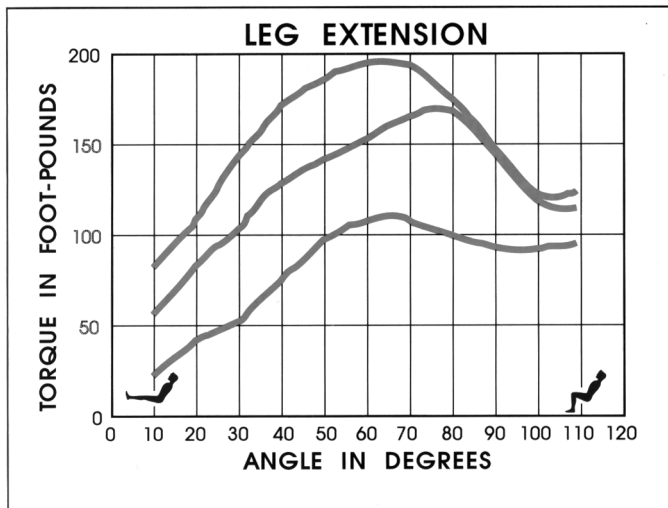
The third chart also shows two tests of fresh strength that were performed five weeks apart. On the left side of the chart the shaded area shows gains in strength that were produced in the worked area, while on the right side of the chart the shaded area shows losses in strength that were produced in the unworked area. Gains on one end and simultaneous losses on the other end of the movement.



By the time we had stopped testing his strength before and after each exercise, thus avoiding any exercise in what we called the unworked area. He was tested only twice, at the start of the last five-week program and at the end of the program.

As stated above, only the leg-extension exercise is capable of producing full-range increases in strength in the quadriceps muscles; and then only if a full range of possible movement is used. But again, according to the “experts” the leg-extension exercise is evil, dangerous, of no value, to be avoided like the plague. Sure.

The last chart shows the results of two tests of the fresh strength of an injured leg and one test of the uninjured leg. The lowest curve shows fresh strength of the injured leg at the start of rehabilitation; while the highest curve shows the fresh strength of the uninjured leg; and the middle curve shows fresh strength of the injured leg about halfway through the rehabilitation program.



Notice that on the right of this chart, in the range of movement near the start of a full-range movement (with the legs bent) the middle curve shows that the strength had returned to normal in that part of a full-range movement; but during a large part of a full-range movement the strength of the injured leg was still far below that of the normal leg. This occurred as a result of the stupidity of the therapist who was in charge of this rehabilitation; believing, as a lot of people do, that exercise performed near a position of full extension of the legs produces high and dangerous levels of compression forces on the knees, this therapist would not permit the subject to exercise near the

extended position, limited the exercise to the other end of the movement. So, in the positions where exercise was performed, his strength quickly returned to normal; but in positions where no exercise was performed his gains were much less.

At that point, not being equally stupid, the subject told the therapist to go to hell and took charge of his own rehabilitation, started performing full-range exercise, and quickly returned to a normal level of strength throughout the full range of movement. In fact, at the end of rehabilitation the injured leg was actually somewhat stronger than the normal leg.

In spite of a rather common belief on this subject, there are literally no compression forces on the knee near the end of a full-range movement of leg extensions; the compression forces that do occur are found in the position where the knees are bent. So some therapists avoid the area where there are no compression forces while working in the area where compression forces are highest. I would strongly suggest that anybody dumb enough to share that common belief should study the laws of physics as they apply to a block and tackle. If they are smart enough to understand these simple laws of physics, which I doubt.

## The Arthur Jones Collection

The second point demonstrated by this chart is related to a matter that I have mentioned in earlier articles in this series: the selective nature of atrophy. Fast twitch fibers atrophy faster and to a greater extent than slow twitch fibers.

When worked to a point of failure following ten repetitions the injured leg showed a loss of 11 percent of its fresh strength, which is a slow-twitch response to exercise. Halfway through the rehabilitation, having gained strength in the meantime, the muscle lost 25 percent of its fresh strength when worked in the same way. And, at the end of the program, with fresh strength back to normal, the muscle lost 44 percent of its fresh strength from the exercise, which is a fast-twitch response to exercise. It thus appeared that his fiber type was changing as he became stronger; but that is a misleading impression, no actual change in fiber type occurred; instead, he was reactivating previously atrophied and nonfunctional fast-twitch fibers.

In addition to the utterly stupid opinions outlined above, I would certainly appreciate it if some of these “experts” would tell me just which compound (Closed Chain) exercise that they would suggest for developing your neck muscles, or your forearms, or your calves. To say nothing of the most important muscles in your body, the muscles that extend your lumbar spine; which muscles will respond only to single axis, isolated (so-called Open Chain) exercise.

And while a certain amount of development can be produced by compound exercise for the biceps, the triceps, the pectorals, and the deltoids, it is also true that developing any of these muscles to anywhere close to their true potential size or strength is utterly impossible without the use of single axis (Open Chain) exercise. Did you ever see anybody with really big arms who never performed curls?

The owner of one company who is now selling aerobic exercise machines has stated that he intends to introduce a line of strength-building exercise machines; but having been hoodwinked by two idiots that are associated with him into believing that single axis (Open Chain) exercises are dangerous, he intends to market only compound (Closed Chain) exercise machines. He means well, he has merely permitted these two fools to mislead him.

As I have stated in earlier articles in this series: we are still stuck with most of the myths and superstitions that existed in this field fifty years ago, while even more myths are added every year that passes.