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Lumbar Muscle Strengthening & Rehabilitation

· *The MedX Lumbar Extension Machine* ·

Brian D. Johnston

Note: Various concepts and descriptions may appear vague or new. For further understanding and education, refer to the MedX (Arthur Jones) Certification, or *The Arthur Jones Collection* at www.ExerciseCertification.com.

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Introduction

Spine health. This likely is the most critical area and concern of the human body as it pertains to mobility and normal function, yet millions around the world suffer from pain associated with the lumbar, thoracic and cervical spine areas. Over a decade ago, in 1991, it was determined that total medical, indemnity and indirect costs related to back injuries range from $25-$100 billion annually in the USA alone.[1] This figure has not improved.

As a result, it is with little surprise that the medical and fitness industries continue to focus so much of its efforts on improving and rehabilitating the tissues of the spine and providing specialty services. Unfortunately, the direction taken by most health care professionals, including fitness practitioners is erroneous, often of little benefit, and sometimes dangerous. And in most cases, the directions are unfounded, nebulous, and unscientific. I say this without reservation based on experience, and data supported by the National Council on Compensation Insurance that indicates costs for back injuries continue to rise[2]. And the use of $30 exer-balls or the direction of typical injury prevention programs in the work place simply will not do or have been of benefit.

The MedX Core Lumbar Strength Machine

[1] Cats-Baril, W. and Frymoyer, J. The economics of spinal disorders. *The Adult Spine: Principles and Practice*, 85-105, 1991.

[2] National Council on Compensation Insurance. *Worker's compensation back claim study*. Boca Raton, FL 1993.

As with cardiovascular disease, it has become apparent that lower back injuries rarely are the result of single catastrophic events. Rather, they occur from years of inactivity that produce progressively weak, deconditioned muscles that eventually fail even under very light physical demands, such as bending over to pick up a dropped pencil or tying one's shoes. This phenomenon has been demonstrated through magnetic resonance imaging that revealed considerable atrophy of the lower back muscles as early as the second decade of life,[3] even among athletes[4], people who most would consider to have strong lumbar muscles. Atrophy of the lumbar muscles is not noticed (until injury occurs) since there is no comparison (unlike comparing left and right arms or legs) or an easy way to measure or quantify the muscles' appearance or dimensions. Also, the hips, gluteals and thighs tend to assume a greater burden of work as the lumbar muscles continue to atrophy, even in normal, healthy individuals who exercise regularly.

Fortunately, if the right tool is available, lower back strength can increase by several hundred percent (primarily since deconditioned muscles have so much strength to regain). However, if that tool is not available, and no matter how hard a person may exercise by other means, lower back atrophy and an increased risk of injury is highly possible.

The Right Tool for the Right Job

With experience in a MedX rehabilitation clinic, I have come to realize the importance of proper, scientific testing and exercise procedures. There are many features to the MedX Lumbar Extension Machine[5], with one of the most notable being isolation of the exercised muscles. The term "isolation" seems to be the bugaboo expression of the past decade as many fitness and health-care professionals opt for 'integrated' movements and working the muscles of the spine by way of stabilization/balance exercises. Apparently isolating a muscle does not produce 'functional' change since the body does not function in an isolated manner. However, one aspect is irrelevant to the other, and quite obvious with the muscles of the lumbar spine. To clarify, we will look at this objectively and scientifically.

First, healthy and normal lumbar muscles have a range of motion of 72-degrees (see illustration 1). Most 'integrated' (e.g., multi-muscle pulley exercises) or 'balance-based' movements (e.g., Swiss ball exercises) affect only a small portion of the lumbar muscles' range, and there certainly is little overload within that range since more focus is spent on maintaining a particular body position and while the hips and thighs contribute to most of the work.

Second, to work the lumbar muscles through their full range, the hips and thighs *must* be restrained.[6] This is accomplished with the MedX Lumbar Extension Machine in four ways, and as shown in the illustration on the next page:

1. Force imposed against the bottom of the feet is transmitted by the lower legs to the femurs at an angle of approximately 45-degrees. Resulting force is produced in two directions; most of the force will drive the femurs toward the rear, thus pushing the pelvic/hip sockets to the rear; while more force will push the knee ends of the femurs upwards.
2. A restraint pad located over the knees (that restrain the upper and lower legs) to limit upwards movement of the knees.

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[3] Parkkola, R, and Kormano, M. *Lumbar disc and back muscle degeneration on MRI: correlation to age and body mass.* J Spinal Disorders, 5: 86-92, 1992.

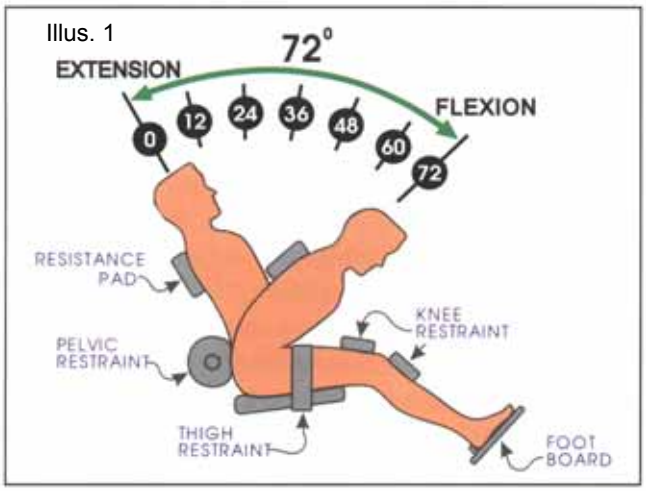
[4] Carpenter et al. *Low back strength comparisons of elite female collegiate athletes.* MedSci Sport Exerc, 26(5): S1: 3, 1994.

[5] Recommended as the key method of exercise and rehabilitation by the Wall Street Journal, March 8, 2005, page D5.

[6] The human spine is not suited ideally to be in a vertical position, which is why so many of us suffer from lower back problems, as opposed to other animals. Consequently, we need to realize the limitations of our physiology and the effects exercise can produce. And one of those limitations is the fact that the hips and thighs do produce the majority of movement and force production when bending forward or straightening up, while the lumbar muscles continue to atrophy from disuse. For four-legged animals and primates, this is not a concern.

3. A thigh belt mechanism that prevents upward movement of the upper thighs and pelvis, by acting as a fulcrum to redirect the upward force of the knees to a downward force on the pelvic/hip sockets.
4. A pelvic pad that prevents (backward) movement of the pelvis in the direction of extension[7].

Although workloads (viz., the ability to lift more weight) can increase with any exercise for the lumbar muscles, whether the hips are restrained or not, it has been demonstrated that only when the hips are restrained will the function of the lumbar muscles increase. Otherwise, the hips become stronger, thus enabling an increase in the workload.[8] This is why typical exercises, including so-called 'functional' exercises on Swiss balls and the like do not work the lumbar muscles adequately. Consider the traditional deadlift, for example. Proper mechanics calls for the *stabilization* of the lumbar muscles to avoid spinal flexion and possible injury, while the hips and thighs do most of the work. Consequently, the lumbar muscles are under sufficient strain, but at a fixed point within a possible 72-degrees of movement, and function will improve only at that point.



If the reader is unaware, many lower back injuries are the result of either compressional forces (requiring spinal traction[9]) or, more frequently weak muscles. The above paragraph should make it obvious that restricting exercise for the lumbar muscles within a limit range can and will reduce muscular function (strength) at the non-worked ranges. Other exercises are no better in providing full range exercise, including the hyperextension, reverse hyperextension, and stiff-legged deadlift exercises. The latter of which increases the risk of injury because of inevitable spinal flexion, and the former two of which affect the lumbar muscles only at the most contracted position while working the hips and hamstrings far more during the remaining 90% range of motion.

Even if traditional exercises could stimulate the entire 72-degrees range of motion, which they cannot, the fact remains that some positions in each exercise would experience greater strain than in other positions. Consider the barbell biceps curl, whereby the middle position (when the forearms are parallel to the floor), or the sticking point, limits how much weight can be used, and which limitation reduces significantly the strain experienced by the biceps on either end of this joint position, a situation that exists with many other free weight exercises, such as comparing the top and bottom halves of the bench press. The same is true of any other traditional methodology, whether using a pulley system or Swiss ball in order to work the lumbar muscles; one position will be the most difficult, whereas the remaining range of motion is not nearly as difficult, and sometimes easy to perform.

[7] There is no tendency for the top of the pelvis to move forward as the spine flexes forward, and so no attempt is made to restrain the pelvis in this regard.

[8] Graves, James E., et al. *Pelvic Stabilization During Resistance Training: It Effects on the Development of Lumbar Extension Strength.* Arch Phys Med Rehabil Vol 75, February 1994.

[9] Proper exercise, as afforded by the MedX Lumbar Machine, can help to hydrate the discs of the lumbar spine, to help relieve pain caused by minor and chronic spinal compression. This occurs as circulation increases around the spinal column, which hydration helps to expand spinal disk spacing.

The only way to produce sufficient stimulus throughout a full range is to account for leverage changes and muscle force capabilities by way of direct, variable resistance, which the MedX Lumbar Extension Machine affords. As stated, this machine also allows the user to restrain the hips and thighs, and even limit the range of motion for those with lower back difficulties and restrictions: the same features as found in the $25,000 medical model (Photo 1) that was developed as a result of $90 million and 20 years of research with the University of Florida.

The MedX Lumbar Extension Medical Testing Machine

As with those who believe exercise must involve integrated movement, such as physiotherapists having patients pick up boxes off the floor and placing them overhead on a shelf to supposedly exercise the lumbar muscles, the argument arises that human function entails multi-muscle activity, and that a high degree of isolation is not warranted or desired. It is like saying that a person should not perform biceps curls (machines or free weights) to optimize biceps strength and development, and that the strain of chin-ups and rowing is sufficient in that regard; yet, no such case exists. Certainly larger biceps by way of curling weights will enhance one's ability to perform chin-ups. If this were not true, then it could be concluded that smaller and weaker biceps would enhance chinning ability, which is illogical and contradictory to the purpose of strength training.

Put it this way, if a column holding up the ceiling of a house was weak, then it would not make sense to improve the structure of the flooring, walls, and roof. Rather, efforts must be made to improve the function of the column specifically so that the house is more structurally sound overall. This morsel of common sense is obvious in architecture and home renovation, but escapes many in the fitness and rehabilitation fields.

The point is: There is a difference between optimizing exercise (or rehabilitation) for a muscle and utilizing that muscle in a specific activity that requires specific skills. The two should not be confused. Properly conducted exercise and activity outside the gym are two different things. The concept of proper (strength training) exercise is to move a resistance through its possible range of movement, to enhance development and strength (a structural change) throughout the greatest possible range of movement. Daily activities do not involve such considerations, and we often place our bodies in their strongest positions of leverage to perform tasks most easily. However, when the time and conditions necessitate an extreme or unusual body position while under strain, as is common in many sports, it is beneficial that the tissues' integrity, enhanced by proper, full-range exercise can withstand said forces.

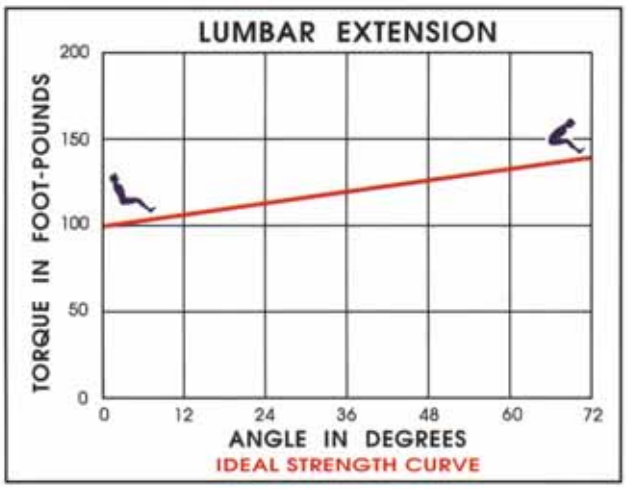
To clarify this position, consider a person who has evenly and optimally developed and improved the function of his lumbar muscles with the MedX machine, so that strength has improved from the point of 72-degrees (full flexion) to the point of 0-degree (full extension). Next, consider that a second person has integrated deadlifts and various cable and Swiss ball-based exercises, and achieved some limited range benefit; say, between 24 and 48-degrees of a possible 72-degrees (a best-case situation with most exercise enthusiasts). Now, suppose both of these individuals competed in football and both were tackled in a position of 60-degrees spinal flexion. Which do you think will be better able to sustain an injury to the lumbar spine and its associated tissues (with all other factors remaining equal)? Certainly the lumbar muscles are not unique in this regard, and the same would be true of the cervical spine, the hamstrings, the knee joint, etc., in that function of a structure is dependent upon how much force that structure can withstand at any particular point within its range of motion.

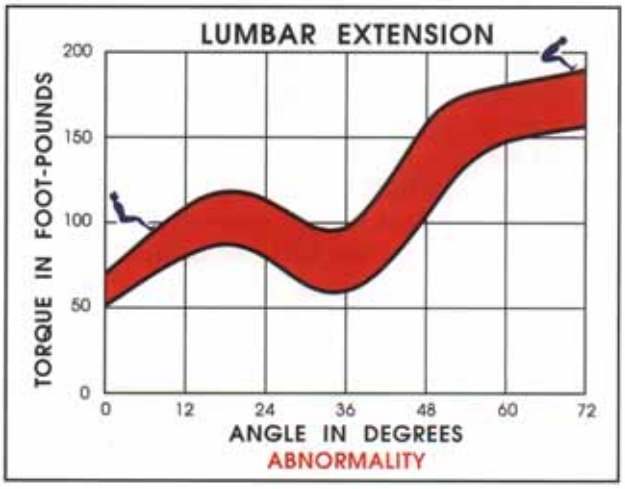
Structural Testing

The specific application and technology that constitutes the MedX Lumbar Extension Machine should make it an obvious choice for any clinic or fitness facility. However, "trying is believing," and I encourage the reader to attend any major fitness expo or conference for a test drive. I also welcome those to visit the I.A.R.T. facility, if in the area, or contact MedX at (800) 876-6339 to locate a facility or clinic that may have this machine. I state this with serious intention, since there is no exercise that I, nor any MedX user has experienced, that can compare to the full range tension, feel and benefits of this machine.

However, the function, design and quality of construction of the MedX Lumbar Extension Machine is only one consideration, albeit the most important. As stated, this machine was modeled on the more expensive medical, computer-based $25,000 version. This latter version allows the clinician to test a number of things, including the measure of force every 12-degrees of movement (used to plot a strength curve and to determine weaknesses at any of those points relative to a 'normal' strength curve), the extent of a person's AE (anaerobic-endurance) Factor, and whether the muscle has a Type S or G strength curve.

Isometric testing is necessary since strength can only be tested in this manner, to eliminate impact forces and to account for the differences in concentric and eccentric ability, the effects of gravity, exact positioning (to duplicate testing) and stored energy. Plotting a curve also helps a clinician to determine whether the strength curve is normal or abnormal, both in shape and in ratio between flexion and extension.[10] The latter two factors require more detailed explanations, since they are highly relevant to fitness prescription and can be determined and utilized with the exercise version of the MedX Lumbar Extension Machine, albeit with a small investment of a force gauge.





But first, look at the two graphs above. The graph on the left represents a normal shaped strength curve, of a particular shape and without any deviations from normal. So long as range of motion is not hampered, complete testing would occur at positions 0, 12, 24, 36, 48, 60 and 72 degrees, and the computer program would interpolate strength in intermediate positions in order to graph a full-range strength curve.

[10] The average flexion:extension strength ratio, which describes the balance of muscular strength through the range of motion, is 1.97:1. In general, a flexion:extension ratio greater than 1.40:1 represents functional weakness in the extended portion of the range of motion, and a flexion:extension ratio less than 1.40:1 represents functional weakness in the flexed portion of the range of motion.

The graph on the right shows a number of things. The top black line represents a force test (at the same positions) of an actual subject taken before a set of exercise on the lumbar extension machine, and the curve clearly is abnormal in shape with a significant strength deficit between 24 and 48 degrees. The subject's greatest force output was at 72-degree, at approximately 190-foot pounds. His weakest position was at 0-degrees, about 70-foot pounds. In order to provide proper exercise, a clinician would have to consider the weakest position and use approximately 70-80% of that figure (about 50-pounds resistance in this case) to exercise the lumbar muscles.

The bottom black line on the same graph is a second force test taken immediately after a set of exercise on the lumbar extension machine. The curves are nearly identical in shape, which suggests that the subject was not a *malingerer* and tried very hard in both tests.[11] The red shading between the two tests represents the amount of fatigue this subject produced from a single set of exercise for the lumbar muscles, carried to the point of muscular failure. Bear these things in mind for the remainder of this report.

The **AE Factor** mentioned previously refers to the relationship of a muscle's anaerobic ability and its endurance. For instance, some muscles are not very strong, but have great endurance, whereas other muscles may be very strong, but fatigue very quickly. In the former instance, the muscle would be of a 'slow twitch' constitution, whereas in the latter instance the muscle would be of a 'fast twitch' constitution, both of which refer to muscle 'fiber types.' An exercise regimen (repetitions/tension time and frequency) for a slow twitch muscle can be devastating for a fast twitch muscle. A slow twitch muscle can tolerate and necessitates more repetitions (a longer tension time) than is reasonable for a quick-to-fatigue fast twitch muscle. Too much activity for a fast twitch muscle can result in overuse atrophy, i.e., muscle wasting from excess activity, apparent in the thighs of long distance runners, and can be experienced quickly if the reader is willing to perform 20 sets for a muscle, several times per week.[12]

The above graph on the right shows how much strength was lost as a result of a single bout of exercise. This subject lost about 20%, although slightly less at the extended position. This would correspond to a mixed fiber type, whereas a slow twitch fiber type would lose very little strength (and sometimes can be stronger after a bout of exercise), and a fast twitch fiber type would lose upward of 30% or more after a bout of exercise.

Next, a muscle can be **Type S or G** in nature. Type S means "specific," in that strength can be improved only within the area that is exercised, plus or minus 12-15 degrees. For example, if a muscle has a range of motion of 100 degrees, and exercise activity is limited to 40-60 degrees, then strength improvement will occur only at 40-60 degrees (with minor improvement of 12-15 degrees at either end of the worked range). A muscle that is Type G (general) means that strength can be improved throughout the full range even if only a partial range is exercised (although *best* results will occur in the exercised range).

[11] Faking a test would make it impossible to duplicate a strength curve since the subject cannot see the computer monitor and would not know how much force to produce at any point in the two tests. For instance, if in a particular position a person can produce 100 pounds of force, and then moments later produces only 60 pounds of force, it is evident that the person is not trying as hard, for whatever reason. Less apparent is when there is a significant difference between tests a week or more apart. It isn't unusual for a person to produce less force on an initial test, if not confident or assured as to what needs to be done when tested (i.e., poor instruction or no trial test to become accustomed of what to do). But the subject should not produce much less or more force a week later if testing is conducted properly. If there are significant changes over the course of a week, and the subject did try as hard as possible, then issues of illness or fatigue, for example, need to be considered, and further tests conducted days later to determine which tests are not true representations of the individual's function.

[12] The lumbar muscles tend to be very susceptible to overuse atrophy (if exercise is specific, as per the MedX Lumbar Extension Machine), and particularly if of a fast twitch constitution. The reason for the lumbar muscles' requirement for less frequent exercise likely is due to the constant tension of which they are under, since they serve to keep the torso erect while sitting or standing, for several hours daily. From my clinical experience, and the research conducted by MedX, one set of specific and intense exercise once every 1-4 weeks is all that is required. Those undergoing injury rehabilitation can sustain more exercise, but not for long, and particularly not as the patient learns to exert greater effort. Those who promote exercise of several sets, several times per week, per muscle, may not believe these findings, but I will not invest time in trying to convince otherwise.

The research done by MedX and the University of Florida has concluded (based on several thousand test subjects) that 80% of people tend to have a Type S response, whereas 20% have a Type G response[13]. In effect, in order to *optimize* full range strength, full range exercise is required, and particularly so with the Type S group.

The issue of full range exercise is a complex issue and it means more than simply moving a resistance from a point of stretch to a point of contraction. Rather, it means providing an equal and sufficient amount of resistance throughout a muscle's range of motion in order to develop equally the entire range of motion. Consider the previous examples of the barbell curl and barbell bench press and it should be apparent that optimum resistance is found only at the 'sticking point' of those exercises and not equally throughout a full range of motion.

There are nine (and possibly ten) factors required for full range resistance, all of which are accounted for with MedX machines, and with some other equipment manufacturers, but certainly not with pulley systems or free weights (or the inclusion of Swiss balls and stability boards).

1. Rotational form of resistance, rotating on a common axis with the involved joint of the body.
2. A direct form of resistance that is directly imposed upon the body part being moved by the muscles being worked.
3. An automatically variable form of resistance that varies instantly as movement occurs.
4. Balanced resistance that varies in accordance with the actual requirements of the muscles in different positions.
5. Resistance that is provided in a stretched starting position; which requires a range of movement in the machine that actually exceeds the possible range of movement of the user.
6. Negative work potential.
7. Positive work potential.
8. Pre-stretching, a factor that is required during the last one or two repetitions of a set of high-intensity (of effort) movements, to enhance contraction and work production.
9. Resistance that is provided in the finishing position of a movement, the only position of full muscular contraction.
10. An unrestricted speed of movement *may* be a requirement, on the basis that no one know what the ideal speed of movement should be and, therefore, it should not be restricted, as per isokinetics or hydraulic-type equipment. Certainly explosive and ballistic style of exercise does not provide full range resistance, even if using variable resistance machines, primarily because the measure of momentum reduces significantly the degree of tension experienced by a muscle throughout the exercise's full range. Consequently, movement needs to be "slow enough."

As interesting as all this sounds, what does it have to do with the MedX Lumbar Extension Machine? Being able to load a muscle properly and optimally throughout the full range of movement, in order to optimize strength potential, certainly embraces the above noted list; that much is known and that technology is found in MedX machines, including the exercise version of the MedX Lumbar Extension Machine. Moreover, it is possible to determine other important factors about an individual's function, including the AE Factor and an appropriate starting resistance based on pre- and post-exercise force tests.

[13] The research was limited to those muscles that could be tested properly, which means accounting for exact positioning, isolation, static testing, counterweighing, and stored energy (non-functional torque). In sum, the muscles of the lumbar, thoracic and cervical spine, and the knee. Nonetheless, there is little reason to believe that other muscles of the body do not respond accordingly.

Refer to Photo 2 below. The subject's lower body is restrained as usual in the machine, with the upper body restrained by way of a nylon strap (encased in a padded sleeve for comfort) across the upper back/shoulders. This belt is attached to a strong, nylon strap looped around the end of the machine, connected by way of a force/strain gauge sensor. The mechanism serves to restrain the subject in an upright position. In effect, the subject can extend the spine as hard as possible, but remains in position for obvious reasons of the restrain mechanism.


Photo 2

There are several reasons why the subject is in this particular upright position (of approximately 30-degrees). First, the subject is in an exact (vertical) position – a position that can be repeated from one test to the next.

Second, if the reader refers to Illustration 1, bending forward in a flexed position necessitates that the subject lift the weight of his or her torso toward an extended position. It would be necessary to account for the weight of the torso in a test, which is something that cannot be done with the exercise version of the lumbar extension machine. Conversely, bending backward in an extended position results in the weight of the torso helping the subject to produce force and, again, weight of the torso would need to be factored into the results. By having the subject remain in an upright position, the influence of gravity (on the mass of the torso), is not in question, but would be in question if the subject were to bend forward or backward and away from a vertical position. Certainly any position could be tested using the set-up in Photo 2, but the results would not be a clear representation of net muscular force.

Third, the influence of stored energy (stretching or compression) of tissues to increase torque is not in question (is near minimal) since the subject is between the positions of flexion and extension, whereas stored energy occurs mostly in the flexed position and with some modest influence in the extended position.

Forth, as stated, the subject is in a static/isometric position, and strength can be measured only statically since dynamics (movement) and the influence of muscular friction can affect test results, neither of which can be accurately measured with today's technology.

The above factors are necessary for proper testing, and the results of a proper test can tell us much about the 'nature' of a muscle and a proper exercise prescription. I can place a subject in the exercise version of the machine and have him or her produce an isometric test, with data read on a force gauge. A 'normal' strength curve of the lumbar muscles will demonstrate greatest force production at the point of flexion (72-degrees) and lowest at extension (0-degrees). At 30-degrees (a seated upright position), the force production would be close to the lowest produced, but not *the* lowest.

From that test, approximately 70% of the value would suggest an appropriate exercise weight. The reason for a 70% prescription is based on two reasons, since 80-85% of a maximum typically is used in traditional exercise. One, isometric ability is greater than concentric ability, and two, a position of 30-degrees should produce more force than what is possible at full extension, and both factors must be considered. Consequently, 70% of an isometric test at 30-degrees is a reasonable approximation. Hence, from that one test, it is possible to prescribe a starting resistance with little trial and error that often occurs when first determining appropriate muscle loading (so long as the individual does not have some type of lower back malady).

To look at a particular example, I produced an isometric test at 30 degrees of 274.6 pounds[14]. I then took 70% of that value (approx. 192 pounds), but rounded up and used 200 pounds resistance; a load that resulted in 70 seconds tension time (7 repetitions at a cadence of 5/5). Immediately after a set to muscular failure, I performed a second isometric test at the 30-degree position. I produced 182.8 pounds of force. The measure of fatigue, as a result of one set of exercise to muscular fatigue, told me several things.

One, I reduced my strength by approximately 40%, a large degree of functional loss, with only 70-seconds of exercise. From this I determined that my AE Factor is in favor of anaerobic ability with poor endurance capabilities, viz., my rate of fatigue is very high and that it best my exercise be limited in repetitions (tension time) and frequency to avoid overuse atrophy, or about 5-6 repetitions at a cadence of 5/5 once every 1-2 weeks, and even less once my lumbar strength and development improves over the initial 10-12 weeks of specific and regular exercise. After all, it takes far less exercise to maintain function than it does to improve function, which is why I can sustain my muscular mass and strength of my other muscles with one hard bout of exercise per week (2-3 sets per muscle), and after 25-years of intense exercise.

Next, and this is my hypothesis based on observation and various experiments with myself and clients, I have determined that a Type G response correlates to a fast twitch fiber type, whereas a Type S response correlates to a slow twitch fiber type, and that I may not need full range exercise to work my lumbar muscles, but that full range exercise would serve me best nonetheless. Arthur Jones, who headed MedX research, discovered a few exceptions to this potential 'rule,' but since there are very few exceptions, I cannot account for these anomalies or the problems that were encountered in measuring and interpreting the results. Whether my correlation is valid or not, it is true that my lumbar muscles are quick to fatigue, and I have a Type G response in those muscles[15].

Hence, the pre-exercise test told me how much resistance to use, and the post-exercise test told me how much lumbar function I lost (how much fatigue I experienced) because of exercise, and my approximate rate of fatigue of the exercised muscles. Such tests would need to be conducted once every month or so, for the initial 5-6 months, since muscles that are weakened from disuse would appear to be slow twitch (ST) in nature (since any fast twitch fibers that may be present in the muscles have atrophied and assume ST characteristics), and regular exercise would change the fatigue characteristics and a person's response to exercise accordingly. (Note: Exercise does not change a muscle's fiber type/rate of fatigue, but the fatigue characteristics of the muscle.) Both factors make exercise prescription more exact and easier to determine, and from five minutes of testing and exercise.

Lastly, I encourage the reader to visit the *Journal of Applied Fitness*, on the IART web site, in Summer 2005. At that time I will have a case study research report on the use of the MedX Lumbar Extension machine and the result of muscular disuse over the course of ten years. In effect, even after a decade of intense squatting, deadlifts and hyperextensions, my spinal erector muscles reduced by nearly 40% in function, but have been returning to 'normal' with the MedX machine. Other case study examples will be reviewed as well.

http://www.CoreSpinalFitness.com

[14] The test involved optimum motivation to produce a maximum measure of force, with a protocol of 2 seconds of modest exertion (to prepare the tissues and *mind*) followed by 5 seconds maximum exertion, and then another 2 seconds of modest exertion to ease off the tension.

[15] When first tested on a clinical MedX testing machine, my lumbar muscles produced a NORMAL strength curve throughout the full range, yet I never exercised those muscles though a full range – limited to tension developed within a limited range via squats, deadlifts, and bent rowing exercises.