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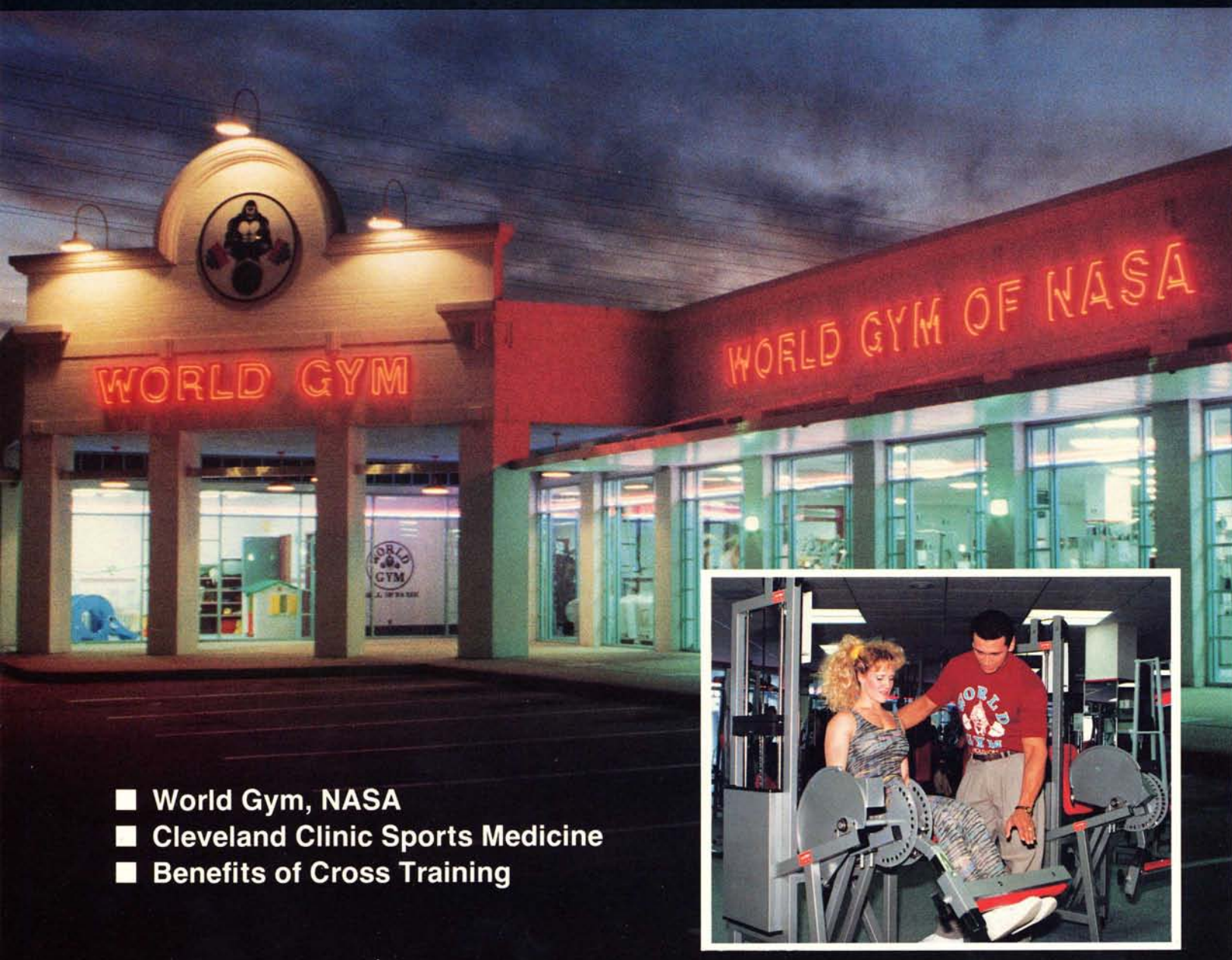
American Fitness

Quarterly



- World Gym, NASA
- Cleveland Clinic Sports Medicine
- Benefits of Cross Training

GENETICS AND STRENGTH TRAINING

Matt Brzycki, Assistant Strength Coach
RUTGERS-The State University of New Jersey

Did you ever notice that some of your athletes make striking gains in size and strength while others make modest gains even though all of them essentially use the same program? In some cases, this may be due to training with different levels of intensity. However, most of the differences in the response to training are primarily the result of genetics. Quite simply, each of your athletes has a different potential for achieving size and strength. Indeed, genetics is the single most important factor for determining your athletes' response to training.

There are several genetic traits which regulate an individual's potential for gaining size and strength. They are: (1) predominant muscle fiber type; (2) muscle-tendon ratio; (3) body proportions; (4) point of insertion/ tendon attachment; and (5) neurological efficiency.

PREDOMINANT FIBER TYPE

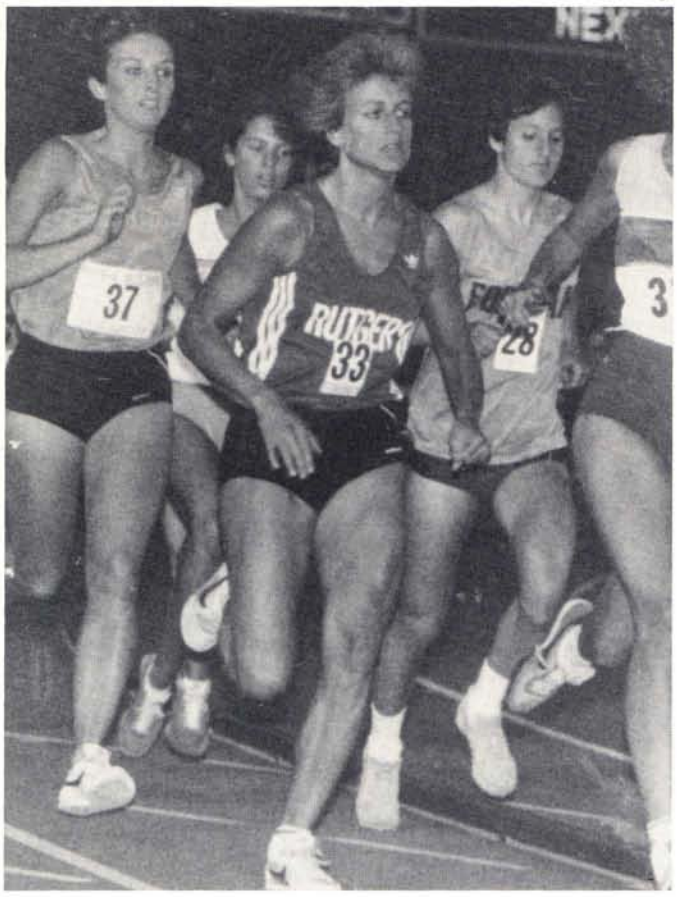
Research has identified at least seventeen subclassifications of muscle fiber types. For the purpose of this article, however, they may be grouped into two major categories: fast twitch (FT) and slow twitch (ST). These two fiber types differ in speed of contraction, force of contraction and endurance capacity. The so-called "fast twitch" fibers can contract quickly and generate large amounts of force but fatigue rather easily. Relative to the FT fibers, the so-called "slow twitch" fibers contract slower and produce less force but have greater endurance.

Everyone's muscles are composed of both fiber types. However, some individuals have a predominant fiber type which allows them to be successful in certain activities. For example, an accomplished sprinter is capable of generating tremendous amounts of force in a short period of time. It's a safe bet that a microscopic analysis of a muscle tissue sample would reveal a high percentage of FT fibers in a sprinter's lower body musculature. On the other hand, a successful long distance runner has a high capacity for endurance. Microscopic analysis would undoubtedly reveal a high percentage of ST muscle fibers in the lower body of a distance runner.

But what are the implications of this for strength training? Well, FT fibers have a much greater capacity for hypertrophy than the ST fibers. This means that any of your athletes with a high percentage of FT fibers are more likely to increase the size of their muscles. Since FT fibers can produce greater force, these athletes will also display a higher capacity for strength gains. In short, an individual's predominant fiber type plays a major role in determining his potential for attaining size and strength.

It should also be noted that an individual's fiber type "mixture" may differ from one muscle to another. Incidentally, to date there's been no conclusive evidence to suggest that you can change ST fibers to FT fibers or vice versa. In other words, you can't convert one fiber type to another any more than you can make a racehorse out of a mule! Therefore, the belief of "low reps with heavy weight for size" and "high reps with light weight for tone" is entirely anecdotal with absolutely no factual basis. Moreover, there is no definitive proof to imply that you can increase the number of your muscle fibers (hyperplasia). Unless, of course, you happen to be a cat! In short, you simply can't change your genetics.

Most of those involved in strength training have seen "Percentage of Maximum Charts" along with guidelines that tell you how many reps you should do with a given percentage of your maximum lift. Unfortunately, it should now be obvious that everyone has a different capacity for endurance based on their fiber type mixture. For example, some athletes may be able to achieve twelve or more reps with 80% of their maximum while others may never do more than six. Therefore, these charts and their accompanying training schedules are essentially worthless except for a relatively small segment of the population who happens to have a specific mixture of fiber types that correctly corresponds to a prescribed number of repetitions. So, unless your athletes are also elite competitive weightlifters, don't waste your time by trying to train them like members of the Cimmerian National Weightlifting Team!



MUSCLE-TENDON RATION

Another factor that determines an individual's potential for gaining size and strength is the muscle-to-tendon ratio. In diagram #1, you can see that Athlete "A" has a relatively long muscle

belly and a short tendinous attachment. In comparison, Athlete "B" shows a shorter muscle belly and a longer tendon. The potential for muscular growth is directly related to muscle length. Therefore, an athlete with a muscle length depicted by "A" would have a greater genetic potential for achieving muscular size than an athlete having a muscle length shown by "B". Furthermore, since a bigger muscle is a

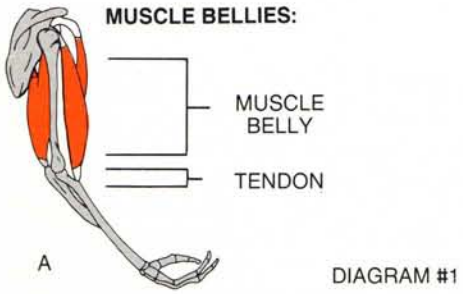


DIAGRAM #1

stronger muscle, an individual with long muscle bellies tends to be exceptionally strong.

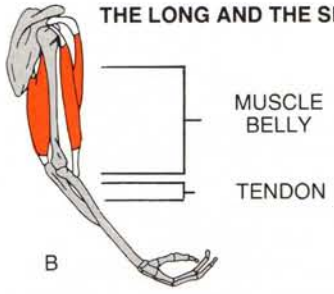
As with fiber type, an individual's muscle-tendon ratio may vary from one muscle to another. It's sometimes hard to tell the actual length of a muscle belly because the muscle may be hidden by subcutaneous fat or lie beneath other muscles. However, the length of a muscle belly is usually most obvious in the triceps, the forearms and especially the calves. Once again, you can't change the length of your muscle bellies.

BODY PROPORTIONS

If you could line up the best bench pressers in the world next to one another, you'd quickly notice that they tend to have the same body proportions. Those individuals who are highly successful in the bench press have relatively short arms and thick chests. This gives them a significant advantage in leverage since they have to move the bar a shorter distance than the average person. The best squatters in the world generally have short torsos, thick abdomens, wide hips and short legs. Again, this biomechanical advantage in leverage allows them to lift extraordinarily heavy weights. The point of this discussion is that body proportions and body types play a major role in the ability to demonstrate strength.

Interestingly, an individual with longer arms may be doing more work than someone else despite lifting a lesser amount of weight. How is this possible? Suppose Athlete "A" has arms that are 30 inches long and can bench press 200 pounds while Athlete "B" has arms that are 34 inches long and can bench press 180 pounds. Since "work" is defined as "weight times distance," Athlete "A" has done 6,000 inch-pounds of work (30 inches X 200 pounds) and Athlete "B" has done 6,120 inch-pounds of work (34 inches X 180 pounds)! Therefore, even though Athlete "B" cannot bench press as much, his effort is actually greater than Athlete "A" because he must move the weight a greater distance.

The ubiquitous "300 Pound" and



"400 Pound" Bench Press Clubs which adorn many weight rooms tend to glorify one's ability to demonstrate strength due to favorable body proportions. The name might as well be changed to "The Short Sleeve Length Club" because in a sense that's what is being measured. Remember, in most cases those with the best bench press also tend to have the shortest arms. Understandably, it's motivating for some of your athletes to walk into a weight room and see their name and maximum bench press in bright lights for everyone to marvel. Hey, you're going to get the big bench pressers into the weight room even if we were under nuclear attack! But what about other athletes who may never make the "300 Pound Club" because of their long limbs? It would certainly be quite frustrating to them as well as intimidating. A coach would be wise to remove these "clubs" from weight room walls and post something which can be attained by everyone like "Most Dedicated Lifter." You'll surely get a much more enthusiastic response from those athletes who are at a mechanical disadvantage in terms of demonstrating strength.

POINT OF INSERTION

At one time or another, most of us have encountered an individual who was stronger than he looked. In fact, he may have been incredibly strong! How is this possible if strength is directly related to muscle size? One possible reason is that the person may have had a favorable point of insertion/tendon attachment. In diagram #2, notice that Athletes "A" and "B" are holding the same resistance in their hands (100 pounds) which is applied the same distance from their elbows (12 inches). The only difference is in their bicep tendon's point of insertion. Athlete "A" has a bicep tendon that inserts on his forearm 1.2 inches from his elbow while Athlete "B" has a bicep tendon that inserts on his forearm one inch from his elbow.

The fact of the matter is that the farther away a tendon inserts from the axis of rotation (in this case the elbow) the greater the biomechanical advantage. For instance, in this example Athlete "A" needs to generate 1,000 pounds of force to hold the resistance in a static position. On the other hand, Athlete "B" must produce 1,200 pounds of force to accomplish the same task. In other words, Athlete "B" must work 20% harder than Athlete "A". In short, Athlete "A" would have greater leverage than Athlete "B" and, therefore, would have a much greater potential for strength gains.

It should be noted further that this illustration is somewhat simplified. At any rate, you can still see how a very small difference in a tendon's point of insertion can make a considerable amount of variation in leverage. Unfortunately, other than X-rays there's only one other way to accurately determine if someone has favorable

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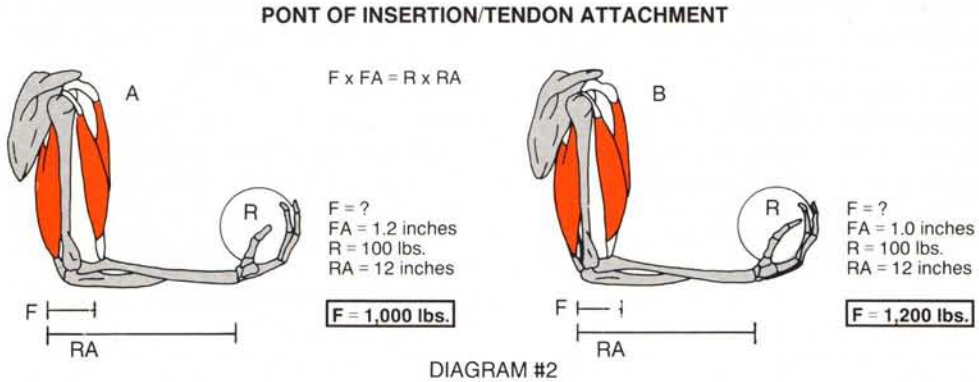

DIAGRAM #2

(continued from page 47)

tendon attachments. However, dissection isn't always practical!

NEUROLOGICAL EFFICIENCY

To this point, our discussion has centered on the effects of one's genetics on his musculoskeletal system. This final genetic factor, however, deals with the nervous system and has been termed "neurological efficiency." This refers to a person's ability to innervate or recruit muscle fibers. Apparently, some individuals can contract a higher percentage of their available muscle fibers than others which gives them a decided advantage in terms of strength potential. For example, suppose Athlete "A" can contract 40% of his available fibers while Athlete "B" can contract 30%. Assuming both have an equal amount of muscle mass, Athlete "A" would have a greater potential for strength since he is able to recruit a higher percentage of his muscle fibers. Again, this is another reason why someone may be far stronger than he appears.

It has been suggested that neurological efficiency is inversely proportional to anaerobic muscular endurance. In simple terms, this means that if you have a high level of muscular endurance, you are probably not very efficient neurologically; likewise, if you have a low level of muscular endurance, you are more likely to possess an efficient neurological system. Using the previous example, if Athlete "A" can recruit more of his muscle fibers than Athlete "B", it follows that Athlete "B" has more fibers in reserve. Therefore, Athlete "B" will generally have greater muscular endurance. Please keep in mind that we are referring to "muscular" endurance and not "cardiovascular" endurance.

CONCLUDING REMARKS

With all due respect to Abraham Lincoln, all men are not created equal! Everyone responds to strength training in a different way because everyone has a different genetic potential for achieving size and strength. An athlete who possesses a high percentage of fast twitch fibers, long muscle bellies, favorable body proportions, low points of tendon insertion and an efficient neurological system will be quite strong as well as physically impressive. In fact, compared to the average person he would be a genetic superman capable of almost unbelievable feats of strength! There are a few individuals like that but most of us are not as fortunate.

The primary reasons for an outstanding response to training are usually maturation and favorable genetics. Be wary of coaches who seek to promote their own stature or strength program by glorifying the accelerated response of certain athletes. It should now be clear that an individual's response isn't necessarily due to a particular program or coach.

Finally, remember that you can't change your genetics. However, that doesn't mean that you can't get stronger. Indeed, we should encourage and challenge our athletes to become as strong as possible within their genetic profile.