Starting Strength

Strength and Prevention of Injuries

by

Mark Rippetoe

Highly-motivated highly-talented athletes will push themselves to the edge of their abilities in an effort to win, since winning is what athletes do. Winning on the field of play takes precedence over everything else, and athletes must rely on their training to prepare them for operating at limit-capacity on game day. Operating at limit capacity is by definition more dangerous than the training environment which prepares for this performance. An athlete's strength training program *should* provide some measure of protection against the risk inherent in pushing the performance envelope, by enhancing strength, speed, agility, power, endurance, and toughness. However, torn ACLs and worse remain common at all levels of competitive athletics.

Strength is the ability to apply force to an external resistance, like the ground, an opponent, an implement, or a ball. Strength produces human movement; it's one thing that distinguishes us from plants and rocks.

There is only one type of strength: the force of contraction which the muscles exert against the bones. Skeletal components in motion apply force using the hands and feet against objects in the environment. Greater strength simply means a higher level of force production, and greater strength increases an athlete's ability to effectively interact with the environment during competition. So it's very simple, really: greater strength is the ability to move a heavier weight, since strength is the production of force.

It's not terribly difficult to understand that training programs which gradually increase the athlete's ability to move heavier loads will increase an athlete's strength. And all the other physical capacities that depend on strength improve as well. One of the most important reasons Emmitt Smith played 13 seasons so effectively with the Dallas Cowboys was the fact that he was very, *very* strong. Strength is, in fact, the basis of physical performance, and to the extent that an athlete who is not already very strong can become stronger, that athlete's performance improves with an increase in strength.

But strength is also pivotal in preventing the injuries that occur at the edge of the performance envelope, and it's easy to understand this too.

An athlete's performance consists of the execution of a skilled activity that is dependent on the production of force within a specific movement pattern or group of movement patterns. Some sports employ a large number of movement patterns that are non-repetitive, depend on evolving conditions on the field of play, and are performed as the situation requires – football, judo, and downhill skiing. In other sports the movement patterns are limited in number and require accurate and precise execution,

so a limited number of movements are practiced repetitively for accuracy and precision – the pole vault, throwing the discus, as well as swimming and running. Yes, even endurance athletics benefit from strength training, and here's why.

In both repetitive and non-repetitive motor pathway sports, the activity represents the use of a *percentage* of the athlete's absolute strength – the absolute maximum ability to generate force under training conditions which permit the heaviest weight to be moved. The sport activity itself (unless it is powerlifting) doesn't use 100% of the athlete's absolute strength, since all force production on the field of play is sub-maximal relative to the athlete's absolute ability.

But the stronger the athlete is, the more strength there is available for higher-level execution, and the more sub-maximal the intensity of the execution can become. An athlete working at 60% of his absolute strength has a *bigger buffer* between his limit strength and his optimum accuracy/precision/endurance level than a weaker athlete who must operate at 90% to achieve the same level of performance. And the stronger athlete can produce more force at 60% than a weaker athlete, thus generating a higher performance level with the same relative effort.

All other aspects of two athletes' performance being equal, the stronger of the two is the better athlete. And the stronger athlete is less likely to get injured. The problem with leaving the ground for a jump shot is that you don't know what you're going to land on, and the stronger the player's legs, knees, hips, and back, the more disorganization on the ground they can tolerate. The higher an athlete's absolute strength, the more force it takes to shove a joint into a position of derangement and injury, and the more likely the player is to finish the game – and the season – unhurt. Injuries will always be a part of competitive performance, but an effective strength program diminishes the risk.

The stronger athlete gets that way through good fortune, training, or steroids, sometimes all three if the incentives are there. Fortune is the easiest: some people are simply born stronger than others – more explosive, agile, fast, and field-smart. Like good looks, you either have them or you don't. It's easy to identify such a person, and that's what recruiters do for a living. These athletes are the ones you see on TV, because every high-level athlete is genetically gifted, *and* in the right place at the right time. All dedicated athletes work hard, but the popular athletes whose names you know were born that way. Getting stronger makes these people even better than they already are.

Training is the process of changing an athlete's physical capacity over time. Its specifics depend on the precise task the athlete will perform, when it will be performed, and how often. A marathoner doesn't train like a weightlifter, because the specifics of the physical task are so profoundly different, and the components of the training process – the workouts – must reflect the requirements of the physical task itself. The process must also reflect the current state of physical preparation of the athlete: a freshman in high school doesn't train like a strong, experienced college senior unless his coach is a fool.

And steroids are merely an admission that strength is important, since that's what steroids build. There are no "technique" steroids. People who know they're not strong enough, who don't know how to get stronger or are too lazy to do the work, take steroids instead of training effectively for strength.

Strength training of the athletes is the task assigned to the Strength and Conditioning staff. Since strength is the ability to produce force, the process of getting athletes stronger must involve an increase in force production, and this is just not terribly complicated. It is fashionable right now to make it *appear* complicated, with the use of exercises that are essentially balance problems instead of force-production problems. Balance is the ability to control your own body's position in space, usually relative to the ground. Strength enables this process.

For example, a man standing on the ground with a 500-pound barbell on his back who can squat down and stand back up with it has solved a balance problem. He's also gotten very strong at the same time he got better at balancing, and the strength is certainly one of the primary reasons he didn't fall down. You get what you train for, and if your S&C staff has your athletes performing juggling tricks and dance moves instead of lifting increasingly heavier weights, you get jugglers and dancers who are not as strong as they could be – and should be – even if they still perform relatively well because they are very talented.

The pivotal concept in strength training is the *increase* in force-production capacity provided by the program itself, not by the athlete's inherent maturation. It is true that the process of growing from 18 to 21 years old will improve physical capacity – an 18-year-old kid will get stronger if he merely *fails to die*, because he's getting bigger and older. But let's not confuse this natural process with effective training. If the recruiter puts 55 talented kids on the team, all of whom are strong, powerful, agile, and quick, the coaches will look good even if they leave their athletes' training potential undeveloped, relying instead on what's already there, and what will develop anyway as the kids mature.

Sport or Activity	Injury Rate
Soccer	6.2
Rugby	1.92
Basketball	1.03
U.S. Track-and-Field	0.57
Cross-country	0.37
U.K. Track-and-Field	0.26
Physical Education	0.18
Football	0.1
Squash	0.1
Tennis	0.07
Badminton	0.05
Gymnastics	0.044
Weight Training	0.0012
Powerlifting (competitive)	0.0008
Weightlifting (competitive)	0.0006

Injury rate = injuries per 100 participation hours

Injury rates per 100 participation hours in various sports. From Hamill, B. "Relative Safety of Weightlifting and Weight Training," *Journal of Strength and Conditioning Research* 8(1):53-57, 1994. *[Table reproduced from Starting Strength]*

This is a dangerous, ineffective approach to a rather simple, solvable problem. Strength is protective against injuries, since working at the edge of your ability is where you get hurt. Strong muscles make stable joints, and the knees, shoulders and elbows of an athlete who can correctly squat 500, press 275, and deadlift 600 pounds are much less prone to injury than the same joints on an athlete whose strength coach thinks that balance balls and light weights are a better way to train. An investment in the correct approach to strength training is the best form of prevention – better than any insurance policy.

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