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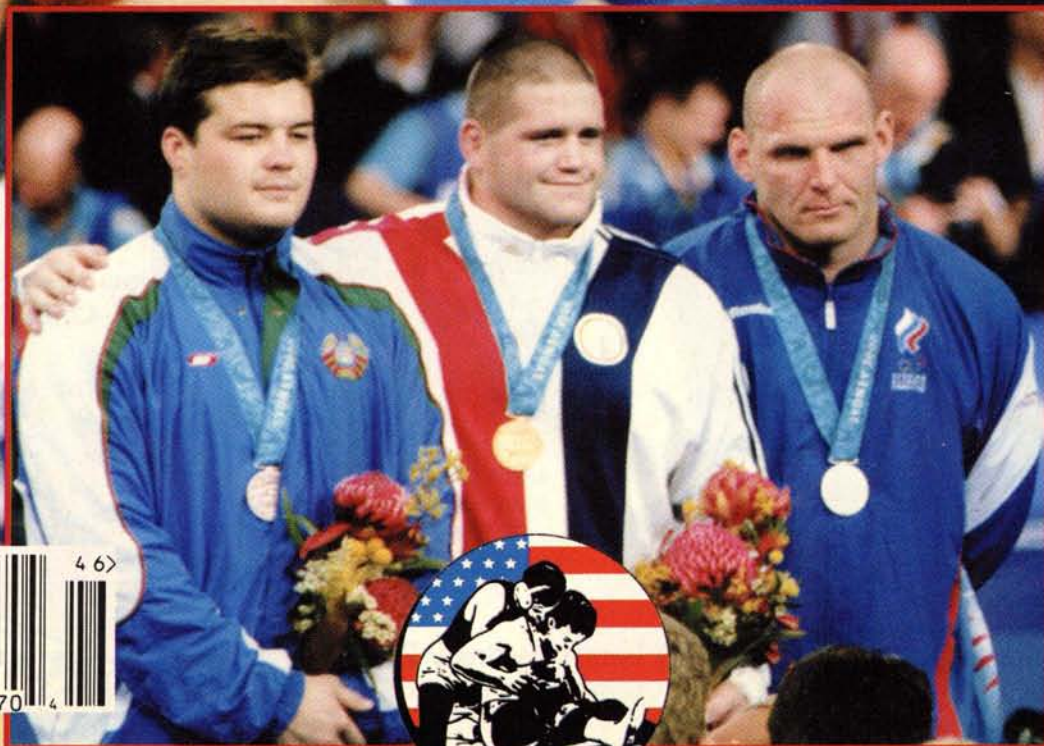
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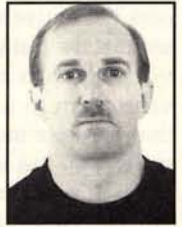
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BARBELL SQUAT

By Matt Brzycki

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One of the most popular exercises in the weight room is the barbell squat. What follows are some of the most common questions that coaches and athletes ask about this movement.

Q: What is the advantage of doing the barbell squat?

A: Everything else being equal, the best exercises for increasing muscular size and strength are those that involve the greatest amounts of muscle mass. That said, one of the most productive exercises for the lower body is the barbell squat.

Q: Is there any disadvantage of doing the barbell squat?

A: Despite the all-important advantage of addressing an enormous amount of muscle tissue, the barbell squat has an inherent disadvantage in that many individuals — because of their body type and/or physical maturity — cannot perform the movement in a safe manner. Indeed, the orthopedic concerns associated with the barbell squat have been voiced since at least the early 1960s. Since then, these concerns have been echoed by a number of highly regarded and experienced strength coaches at the scholastic, collegiate and professional levels.

Q: What are the specific concerns?

A: One orthopedic concern is the knee. In order to maintain balance during the descending phase of the barbell squat, lifters must move their knees forward of their ankles. The farther the knee moves forward, the greater the stretch of the joint and the greater the shear (side-to-side) force at the patellar tendon. As the length of the legs increase, so does the distance that the knees move forward of the ankles. Therefore, someone with long legs is more prone to the shearing or “grinding” effect in the

knees than someone with short legs.

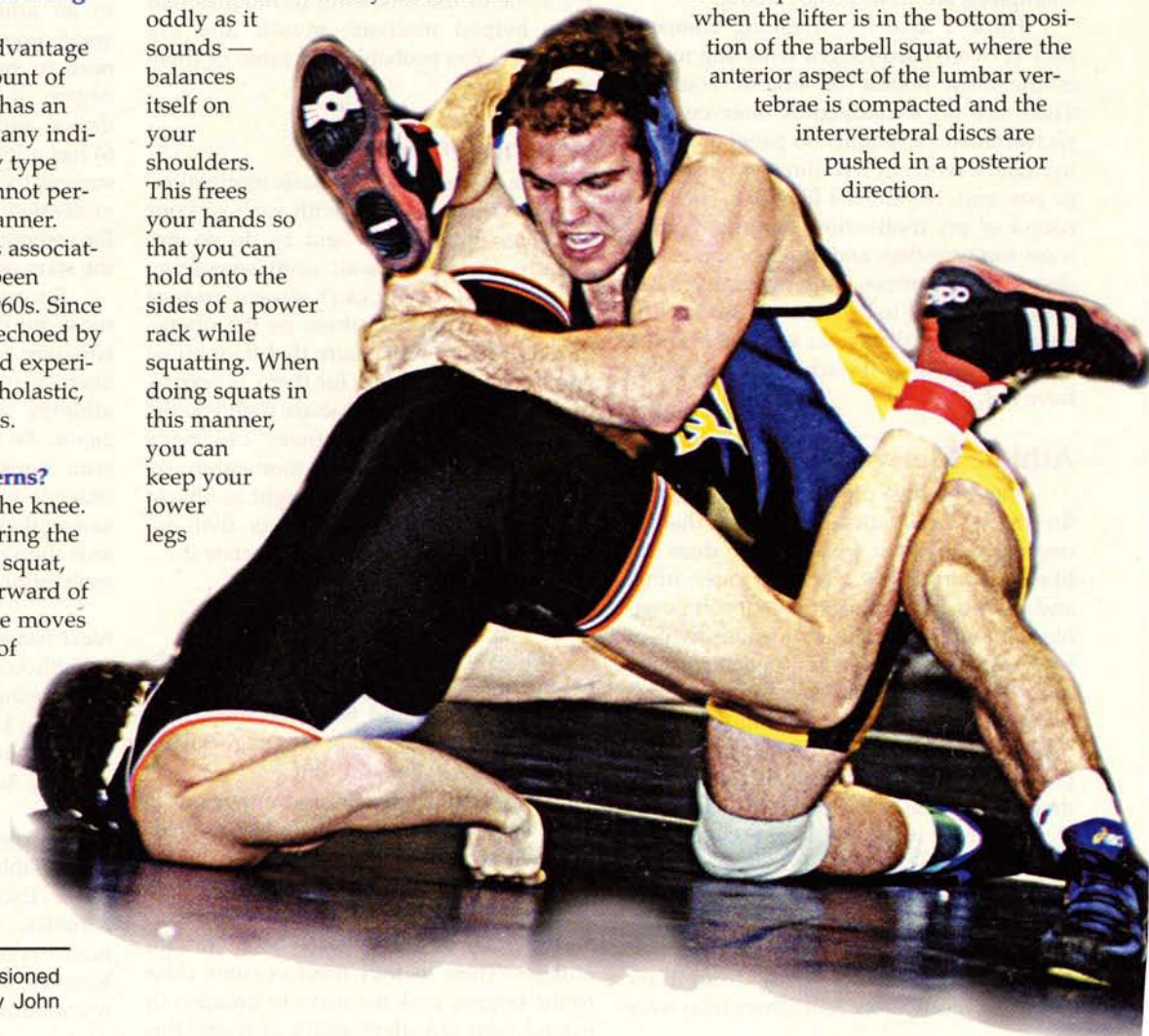
Q: Can this shear force be eliminated or reduced?

A: To minimize the shear force in the knees during a barbell squat one would have to maintain a position in which your lower legs — that is your shin bones — are as close to perpendicular to the floor as possible. Unfortunately, this position cannot be attained because your center of gravity would drop outside your base of support and you would fall backward. However, this problem can be avoided by using what is known as a “safety squat bar.” The bar has a heavily padded, “horse-collar” center yoke that — as oddly as it sounds — balances itself on your shoulders. This frees your hands so that you can hold onto the sides of a power rack while squatting. When doing squats in this manner, you can keep your lower legs

roughly perpendicular to the floor without losing your balance and falling backward.

Q: Some of my wrestlers have told me that their lower backs hurt when they do barbell squats. What can I do to remedy this problem?

A: The lower back is actually a second area of orthopedic concern. And the fact is that you might not be able to alleviate their low back pain, especially if they have pre-existing low-back injuries or histories of lowback problems. Squatting with a barbell on the shoulders compresses the spinal column which, in extreme cases, could result in a herniated or ruptured disc. Compression is most evident when the lifter is in the bottom position of the barbell squat, where the anterior aspect of the lumbar vertebrae is compacted and the intervertebral discs are pushed in a posterior direction.



197 lb. Dave Doebel, (BV), decided on Matt Buskohl, (Wart) 5-4. Photo by John Johnson.

One study revealed that when doing barbell squats with as little as 0.8 to 1.6 times body weight, the load in the low-back region is actually six to ten times body weight. This means that if you weigh 170 pounds and do barbell squats with about 135 - 270 pounds, the compressive load on your lumbar area can be anywhere from 1,020 - 1,700 pounds. The exact amount of loading is a function of how far the weight is from the lower back. Everything else being equal, someone with a long torso experiences higher compressive loads in the lower back than someone with a short torso.

To reduce the compressive loads, have your wrestlers minimize their trunk lean. In other words, instruct them not to bend forward excessively at the waist when they do their repetitions. Having them keep the bar lower on their shoulders rather than near or on the base of their necks will help reduce their forward lean.

Q: Can't you alleviate low-back pain by wearing a weightlifting belt?

A: A few studies have shown that wearing a weightlifting belt while squatting with a barbell increased intra-abdominal pressure which reduced the stress on the lower back. Wearing a weightlifting belt may also provide a psychological benefit.

Q: Are there any alternatives for those who can't squat safely?

A: Fortunately, there are safer ways of addressing the extensive musculature of the lower body without the inherent risk of injury to the knees and lower back. First, be aware of the general body type that has a higher risk of injury from the barbell squat, namely individuals with relatively long legs and upper torsos. An excellent alternative for those with this body type — and others who can't squat in a safe manner — is the leg press which is essentially the squatting motion without any vertical compression of the spine. In addition, you have the freedom to position your lower legs so that there is minimal shear force in your knees.

Q: Isn't there a difference between performing a squat with a barbell and doing a leg press with a machine?

A: In terms of your response, not much. The fact of the matter is that any exercise that progressively applies a load on the muscles will stimulate improvements in muscular size and strength. The barbell squat and the leg press address the same major muscles. In this case, it's the hips, quadriceps and hamstrings. Although the act of balancing free weights certainly requires a greater involvement of syner-

gistic muscles, there's no evidence that this results in a significantly greater response. Indeed, studies have shown that there are no significant differences in the development of muscular size and strength when comparing groups who used free weights and groups who used machines.

The bottom line is that your muscles don't have eyes, brains or cognitive ability. Therefore, they can't possibly know whether the source of resistance is a barbell, dumbbells, a selectorized machine, a plate-loaded machine or another human being. The sole factors that determine your response from strength training are your genetic makeup and your level of effort — not the equipment that you used.

Q: But isn't it better to do the barbell squat because it's ground-based training?

A: The notion of "ground-based training" has been receiving increased attention since the mid 1990s. Basically, ground-based training is the belief that since — for the most part — athletes compete with their feet in contact with the ground then that's how they should lift weights. In other words, it is the belief that all exercises should be done while standing. In response to this assertion, Jeff

Watson — the Strength and Conditioning Coach at Villanova University — once asked, "Does this mean that you can't get stronger while sitting or lying down?" Obviously, you *can* get stronger in an exercise even though it isn't done in the standing position. Many wrestlers know this from personal experience because they've improved their strength in exercises that are performed while sitting or lying down such as the lat pulldown and bench press. So, the notion that the barbell squat is better than the leg press because it's ground-based training is well-meaning but without merit.

Q: What if I'm not the ideal body type to do the barbell squat but I don't have access to any other equipment to train my hip area?

A: If this is the case, your primary goal is to reduce the compressive loads and shear forces. You have at least two options for the barbell squat. One is to use a lighter weight and perform it with a speed of movement that is slower than that normally used. This will decrease the orthopedic stress on your knees and lower back. A second option is to pre-fatigue your hips prior to doing the barbell squat. For example, you could do hip abduction

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using manual resistance with the aid of a partner. Once you finish this exercise, quickly move to the barbell squat. Because you pre-fatigued your hip area, you won't need to use as much weight as usual which will reduce the orthopedic stress.

Q: For my wrestlers who can squat safely with a barbell, how often should they max out?

A: Often, workouts that incorporate the barbell squat — and other exercises for that matter — quickly morph into versions of a powerlifting contest with sets leading up to one-repetition maximum (1-RM) attempts. The focus on low repetition sets with heavy weights usually leads to a greater reliance upon various supportive paraphernalia — such as knee wraps, squat suits and so on — which contribute less to the *development* of strength and more to the *demonstration* of strength. Any injuries that occur from this type of squatting are inexcusable. The squat can be a very productive exercise — but it doesn't have to be done like a competitive lift. Even if you have wrestlers who are also competitive powerlifters, they don't have to do low repetition sets until they get close to a contest.

Q: So how many repetitions should they do?

A: Have your older wrestlers (juniors and seniors) use a repetition range of about 15 - 20; your younger wrestlers should use a slightly higher repetition range of about 20 - 25 repetitions.

Q: Don't higher repetitions build muscular endurance instead of muscular strength?

A: It has been believed that doing higher repetitions (with a lighter weight) builds muscular endurance and doing lower repetitions (with a heavier weight) builds muscular strength. Actually, muscular endurance and muscular strength are directly related. If you increase your muscular endurance, you will also increase your muscular strength. Here's an example: Suppose that your 1-RM squat is 300 pounds and you can do 20 repetitions with 75% of your 1-RM (225 pounds). And after several months of strength training using high repetition sets, suppose that you've progressed to the point where you can do 247.5 pounds for 20 repetitions. Given that you increased your performance in a 20-repetition squat by 10% — from 225 to 247.5 pounds — do you think that your 1-RM strength will be greater than, less than or equal to your previous 1-RM effort of 300 pounds? My guess is that it will be greater. So, even though you

trained with higher repetitions, your muscular strength increased.

By the way, it works the other way as well. If you increase your muscular strength, you will also increase your muscular endurance. Here's why: As you get stronger, you need fewer muscle fibers to sustain a submaximal effort (muscular endurance). This also means that you have a greater reserve available to extend the sub-maximal effort.

Q: How fast should the repetitions be done?

A: No one knows exactly how fast — or how slow — a repetition should be performed. But one study does offer some food for thought. A subject squatting with 80% of his four-repetition maximum incurred a 225-pound peak shearing force during a repetition that took 4.5 seconds to complete and a 270-pound peak shearing force during a repetition that took 2.1 seconds to complete. This is clear evidence that slower speeds of movement reduce the shear force on joints.

Q: Should my wrestlers lock their knees between repetitions?

A: No. There are two reasons why they shouldn't "lock" or completely extend their knees. First of all, it unloads their muscles which makes the exercise less effective. Second, it increases their risk of hyperextending their knee joints which makes the exercise more dangerous.

Q: How deep should you go during the squat?

A: For the most part, you need only squat to a depth in which your upper legs are approximately parallel to the ground.


Q: How can I reach this depth in the squat without losing my balance?

A: If you can't squat to a point where your upper legs are parallel to the ground, it may be because your stance is too narrow. Spread your feet slightly wider than shoulder width apart. Also, keep your toes pointed outward slightly. These suggestions should help you attain a proper depth. By the way, a narrow stance will also increase your trunk lean as you squat which will in turn increase the compressive load on your lower back.

Q: Is it okay for me to bounce out of the bottom position of the squat?

A: No it's not. Bouncing out of the bottom position produces higher compressive loads and shear forces.

Q: What do you think about wearing knee wraps while squatting?

A: Having been a competitive powerlifter, I am not convinced that knee wraps provide any significant advantage in safeguarding the knees against injury. By tightly wrapping their knees, lifters get an artificial boost out of the bottom position of the squat which allows them to use much more weight than normal. This, however, relates more to *demonstrating* strength rather than to *developing* it. To build functional strength in your hip and leg musculature, you'd be better off not using knee wraps or other forms of synthetic support (such as squat suits). 



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