

BFS POSITION PAPER

# *The Parallel Squat*

BFS guidelines on the benefits and risks of this popular exercise



**T**he parallel squat is one of the most effective exercises that can be performed in a strength and conditioning program, but it is also one of the most controversial. Many of the concerns about the safety of the squat can be attributed to misinformation. This paper will discuss the benefits and risks of the squat so that coaches can make an informed decision about whether or not they should include it in their strength and conditioning programs.

The parallel squat is considered the king of all exercises because no other

exercise works as many major muscle groups as effectively as the squat. It also stimulates the cardiovascular system positively and burns more calories in the same time period than any other exercise, and as such also can be a useful exercise for general physical conditioning. Consequently, at BFS we believe that if athletes did nothing but parallel squats, they would have a good weight-training program – not great, but good. Conversely, if they leave out the squats, minimize them, or perform them incorrectly, athletes may not be able to fulfill their athletic potential – especially in

sports that have a high strength component, such as football or wrestling.

We believe that the parallel squat builds the foundation for great speed, regardless of the size of the athlete. A six-foot-four, 265-pound football player who has good athletic ability might be able to run a 40-yard dash in 4.6 seconds if he practices the squat. If that athlete does some other type of free-weight exercise or substitutes an exercise machine for the squat, such as a leg extension, it is unlikely that he will achieve such results. Further, there are some machines and apparatus used for



**FIGURE 1:** It is a myth that squats will make the hips wider and create a “blocky” appearance because the gluteus maximus muscle does not insert on the hips. Shown are Jesse Butterfield (left) and Chloe Van Tussenbroek (right), multisport athletes who have competed in the School Age National Weightlifting Championships. Jesse went on to become a professional model.

squatting that may do more harm than good. One example is the Smith machine.

One problem with squatting using a Smith machine is that although it may reduce the stress on the lower back because the athlete can lean backwards while maintaining balance, it places significantly higher shearing forces (i.e., forces that work to pry the joint apart) on the knees because the hamstrings are not as active during the exercise. Further, squatting with a barbell on a guided vertical (or slightly angled) path does not allow for natural compensations in the movement of the spine, a restriction that can place unnatural shearing forces on the spine.

It also should be mentioned that in four lawsuits in which sports-liability consultant Dr. Marc Rabinoff served as an expert witness, four individuals

became paralyzed using Smith machines because they didn’t know how to properly use the safety apparatus on these machines. That being said, it’s not that machine exercises have no place in an athlete’s training, as they are especially valuable in rehabilitation, but that



**FIGURE 2:** Allowing the knees to buckle is a common error in squatting that must be corrected to prevent injury.

we believe free-weight exercises such as squats should form the core of an athlete’s training.

One myth about squats that has led many athletes and those interested in improving their appearance to avoid them is that they will widen the hips and cause the body to develop a “blocky” appearance. This idea was promoted by the famous late bodybuilding trainer Vince Gironda<sup>1</sup>. Gironda was called the “Trainer to the Stars” because his clients included Hollywood celebrities such as Clint Eastwood, Cher and Denzel Washington. He also trained professional bodybuilder Larry Scott, who in 1965 won the first Mr. Olympia title, and Mohamed Makkawy, who twice placed second in the Olympia. Anatomically, the idea that squats widen the hips is not valid because the insertion of the gluteus maximus muscle, one of the prime movers in the squat, is not on the hips (Figure 1)

Although most high school weight-training programs for athletes include squats, many coaches allow their athletes to squat way too high, use poor biomechanics, such as by allowing the knees to buckle (Figure 2) or leaning forward excessively, and spot improperly (Figure 3). These problems increase the risk of injury and decrease the effectiveness of the strength and conditioning program.

## KNEES AND SQUATS

Are squats bad for the knees? Despite credible, peer-reviewed evidence to the contrary, this question is constantly raised, even by those who have no connection to athletics or physical education.

Much of the controversy originated from the belief that squats were harmful to the knees, an idea that was introduced by college professor Karl K. Klein and medical doctor Fred L.

Allman, Jr. In 1961 Klein published a study that contained some questionable research methods and suggested that squats could decrease knee stability and thereby increased the risk of knee injury. He later detailed his findings in a book he wrote with Dr. Allman, *The Knee in Sports* (Penn State Press, 1971, Figure 4).<sup>2</sup>

In the years that followed it was shown that there were flaws in the study, and the results could not be reproduced. Further, other studies showed exactly opposite results; namely, that weightlifters and powerlifters tended to possess tighter knee joints than control groups and were less susceptible to knee injuries. What is interesting is that Klein and Allman did not disapprove of *parallel* squats, which are recommended by BFS, but *full* squats as performed by Olympic lifters. However, few people have actually read Klein and Allman's book, which says that parallel squats are fine and have benefits to athletic performance.

In the years that followed, weightlifters, powerlifters and sport scientists were eventually able to convince the medical community and lay public that squats were not harmful to the knees and that competitive weightlifters and powerlifters did not have greater levels

of knee instability than other athletes or the untrained population<sup>3,4</sup>. Further, we at BFS contend that performing squats by descending under complete control to achieve a parallel position results in many positive changes, such as the following:

- The lower-body muscles become stronger and bigger, especially the quadriceps and hamstrings.
- The tendons become thicker and stronger.
- The knee ligaments become thicker and stronger.
- The entire articular capsule of the knee becomes thicker.
- The bones of the legs become stronger and slightly bigger because of increased capillarization.
- The cartilage of the knee becomes more resistant to injury.

These positive effects explain why athletes who do squats correctly have far fewer knee injuries than those who do not squat at all. Including squats in their program and performing them properly is especially important for female athletes, because they are up to five times more likely to suffer knee injuries than men are in sports such as basketball and volleyball. According to the American Orthopedic Society for Sports Medicine, each year approxi-

mately 20,000 high school girls suffer serious knee injuries, most involving the anterior cruciate ligament, which helps stabilize the knee.

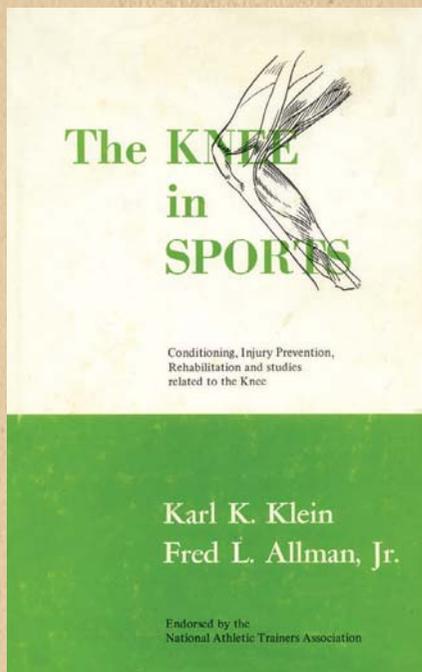
Proper squatting technique offers athletes the best defense against knee injuries. That being said, deep squats can present some danger to the knee joint, especially if the lifter comes down fast, is out of control or bounces at the bottom position. Common sense tells us that a football player who does deep squats with, say, 400 pounds is asking for problems if he comes down hard and bounces at the deep bottom position. But if an athlete lifting the same weight comes down under control to the parallel-squat position and then comes up, the knee joint should be in no danger whatsoever.

### SQUAT DEPTH

Understanding the importance of depth in squats is imperative. We base our standards on a parallel depth or slightly below it. The high school All American standard is 500 pounds for males with heavy builds and 325 pounds for females with heavy builds. The all-state standard is 400 pounds for males and 235 pounds (think two plates and a collar) for females. BFS set those standards to help athletes and coaches



FIGURE 3: Examples of great spotting by high school athletes



**FIGURE 4:** The publication in 1961 of *The Knee in Sports* written by Karl K. Klein and Fred L. Allman, Jr., led to many misconceptions about the safety of the squat exercise.

understand when an athlete achieves something remarkable. Only an exceptional athlete with special understanding of how to do squats can reach those standards. If an athlete squats a foot high, or three inches high with 500 pounds, it is meaningless. Not a whole lot is really happening, and the athlete will miss out on great benefits.

The guiding principle in squatting is that it's necessary to squat so that the tops of the upper thighs are at least horizontal to the floor so that the hamstrings and gluteal muscles are strongly activated. If you don't squat low enough, you only activate the quadriceps (front thigh muscles). It is our understanding that if an athlete does not squat low enough, this reduced muscle recruitment will not improve knee stability and may even decrease knee stability by creating muscle imbalances. And it should be noted that peer-reviewed research suggests that squatting to parallel does not increase the stress

on the patellofemoral joint compared to squatting above parallel.<sup>5</sup> Finally, squatting to parallel is necessary to allow for a natural movement of the sacroiliac (SI) joint. Improper function of the SI joint is associated with many types of lower back pain.<sup>6</sup>

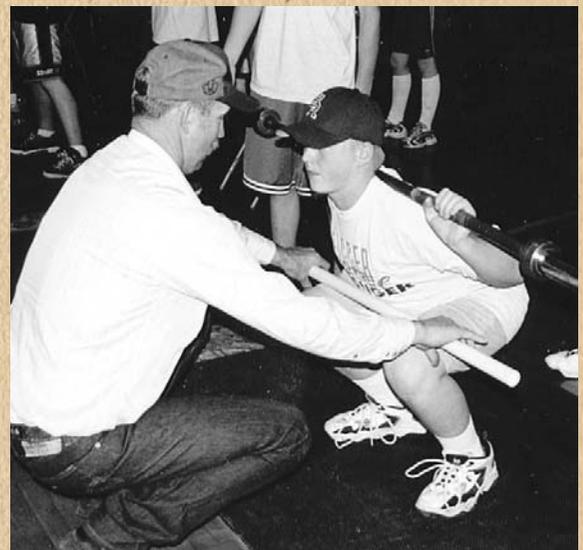
At BFS, we offer a simple test to help athletes and coaches determine the proper depth. It's called the marble test (Figure 5). If an athlete were to place an imaginary marble (or dowel) on the middle of the top of the thighs during their deepest squat position, which way would the marble roll? If the marble would roll towards the knees, the athlete is not squatting low enough. If the marble would stay stationary or roll towards the lifter's hips, the depth is fine. What you'll find by using this standard is that the bottom of the thighs has to be *below* parallel at the bottom of the squat. The marble test is better than judging the position of the bottom of the thigh, as athletes with large legs would be required to squat considerably lower (Figure 6).

Does BFS have any problem with an athlete squatting lower than parallel? Certainly not. All we are saying is that an athlete must squat to at least parallel to effectively work the hamstrings. As for the sport of powerlifting, the extraordinarily high poundages lifted by many of today's powerlifters suggest that there has been considerable leniency among some organizations as to what parallel is, along with the supportive gear that often can add hundreds of pounds to a powerlifter's best result in this exercise. Further, the hyper-wide stance used by many powerlifters, which reduces the forward movement of the knees and minimizes

the involvement of the quadriceps, is not the athletic stance that BFS believes would have the best carryover to athletics. Another way to think about this is to say that powerlifters are trying to lift the heaviest weight possible over the shortest distance possible, whereas at BFS we are trying to lift in such a manner as to have the best carryover to athletics.

Because Olympic weightlifters squat all the way down (Figure 7), and in competition actually bounce out of the bottom position, why doesn't BFS recommend this style? After all, knee injuries to competitive weightlifters are rare, especially compared to knee injuries in other sports. What is wrong with going all the way down?

If an athlete has a qualified Olympic lifting coach to work with them on this squatting method and the coach believes this form of squatting is superior, fine.



**FIGURE 5:** A dowel can be used to help determine the proper depth of a squat.

The problem is when an athlete squats all the way down and relaxes, the knee joint opens up slightly, subjecting the connective tissues to stress levels higher than their tensile strength. In the case of weightlifters, who perform snatches and cleans bouncing out of the bottom position, the stress does not become excessive

because they perform these lifts while keeping the muscles under tension.

Nevertheless, the reality is that a coach in high school may have 50 kids to work with at the same time, and it is difficult for any strength coach to give the one-on-one attention this type of squatting deserves, particularly in light of the fact that there are relatively few qualified Olympic lifting coaches in this country. Further, it's not so much that squatting deep injures the knees but that it places the lower back at a higher risk of injury.

Unless an athlete has exceptional flexibility and proper supervision, what often happens when an athlete squats all the way down is that their lower back will round. Rounding places high, unnatural stresses on the lower vertebrae of the back (L3, L4 and L5). Further, this stress is compounded by the compression forces on the spine, which are estimated to be six times greater at the bottom of a full squat than at the top (so that an athlete squatting 200 pounds would have 1,200 pounds of compression forces at the bottom).

Likewise, using a flat or tail-under back posture (as is often taught in fitness classes to supposedly increase the involvement of the glutes) places excessive strain on the supportive tissues of the lower back. In his book *Facts and Fallacies of Fitness*<sup>7</sup>, the late Mel Siff warned against this technique: "Keeping the back 'flat' is common advice in the gymnasium training environment, yet its validity is rarely questioned. Actually, a flat back devoid of any curvature is not only virtually impossible for a normal person to achieve, but it also reduces the ability of the spine to absorb or distribute shock and stress effectively. The healthy spine is meant to have several different curvatures, whereas the straight spine suggests the presence of a specific type of pathology." Again, if an athlete has exceptional flexibility and one-on-

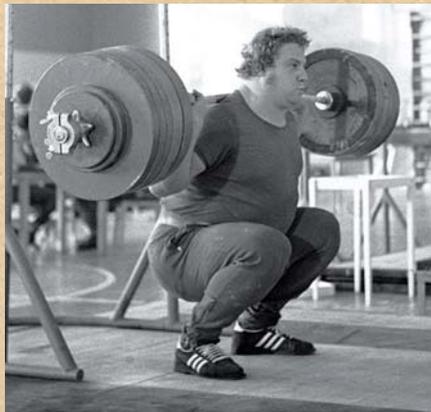


Photo: Bruce Klemens

**FIGURE 6:** Lifters with large thighs will have difficulty reaching parallel if the bottom of the thighs is used to determine parallel.

one coaching from a qualified Olympic lifting coach, it would be better to go with a parallel squat, or slightly below.

Next, there is the mistaken belief that squats invite adverse effects on the cardiovascular system because they cause a rise in blood pressure. It is true that blood pressure rises, but the effect is only temporary and the heart adapts positively to this stress by hypertrophying the left ventricle. It should also be noted that leg presses performed on a 45-degree angle increase the blood pressure significantly more than squats do. Of course, if an athlete has any cardiovascular issues, they must consult with their private health

care practitioner about the effects that squats will have on their condition.

Finally, there is the argument that squatting all the way down doesn't work the quads and hamstrings throughout the full range of motion. That's true, but that's why BFS has made glute-ham raises and lunges *high-priority* auxiliary exercises. Both of these exercises put minimal stresses on the lower back while working the quads, especially the vastus medialis (an inner thigh muscle that crosses the knee joint and is therefore key to maintaining knee stability) and all four heads of the hamstrings.

When BFS started 32 years ago, one of the most controversial aspects of our program was our promotion of the squat. Most of the controversies were a result of misinformation, which we can now resolve with scientific research. Our original claim was that the parallel squat is one of the best exercises for athletes, and we continue to stand by it 100 percent. **BFS**

*Note: A PDF of the complete 5,300-word position paper, including references and detailed instructions on how to perform the squat, is available for download at [www.biggerfasterstronger.com](http://www.biggerfasterstronger.com)*



**FIGURE 7:** Weightlifters squat all the way down, but this depth is not necessary for most athletes and should only be used under the guidance of a qualified weightlifting instructor.

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