Jumping with a hex bar is biomechanically more specific than jumping with a barbell resting on the shoulders. Shown performing a squat jump is Lusia Angilau, a member of the women's volleyball team at Southern Utah. Angilau appeared on our Sep/Oct 2009 cover, and had a 27.1 inch vertical jump in high school.

# Hex Bar Squat Jumps for *Ultimate Power*

## A new peer-reviewed study shows hex bar squat jumps are superior to the straight bar

BY **KIM GOSS, MS**

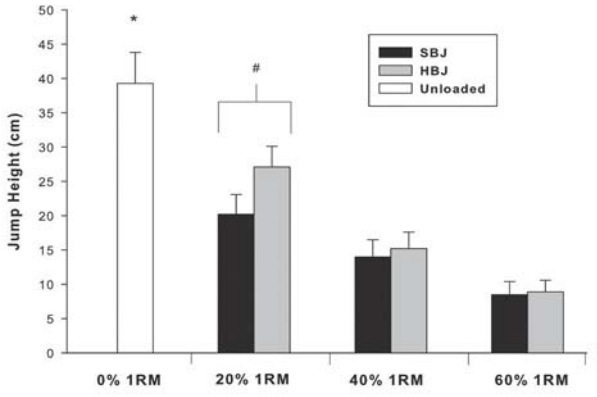
Plyometrics and weight training are proven methods of improving jumping ability, and it only seems logical to find ways to combine both. One method that does exactly that is weighted squat jumps. But the big question is what is the best way to add resistance?

Before getting to the answer, let's do a little review. One of the coaches who pioneered the use of weight training for jumpers was Dr. Vladimir Dyachkov. Dyachkov coached two Olympic gold medalists in the high jump: 1960 winner Robert Shavlakadze and 1964 winner Valery Brumel. Russian track coach and sport scientist Yuri Verkhoshansky sought to expand on Dyachkov's work by developing more-specific exercises for jumping events. Verkhoshansky shared his ideas in a paper he wrote in 1961 entitled "The Barbell in the Training of Track and Field Jumpers."

Nicknamed the "Father of Plyometrics," Verkhoshansky coached jumpers enrolled in the Aeronautical Engineering Institute in Moscow in the 1950s. It was here that he began experimenting with new ways to improve overall athletic power and jumping ability – partly out of necessity due to Russia's harsh winter weather.

Because the Russian winters were bad and the indoor track facilities for the jumpers were worse, Verkhoshansky decided to experiment with special weight training and jumping exercises. At that time the use of weight training for jumpers was not a training method embraced by track coaches – the best way they knew for a jumper to improve their jumping ability was to jump.

In his research Verkhoshansky discovered that the stress on the body




A peer-reviewed study on hex bar jumps vs. straight bar jumps is soon to be published, confirming that the hex bar is a superior method of training.

during the takeoff for the triple jump could reach up to 660 pounds, so to adhere to the concept of sport specificity he tried to find weight training exercises that would replicate this stress. Initially, he tried leg presses (in which the athlete would balance a barbell on their feet) and partial back squats. The problems with these exercises were that the leg press was considered too dangerous and such heavy squats caused lower back pain.

Verkhoshansky addressed the problem of how to significantly overload the legs safely by means of the *depth jump*, which is a specific type of exercise that uses the kinetic energy that develops in the muscles and tendons when an athlete lands during a jump. Stepping off a low platform and immediately rebounding upward upon landing is considered one type of depth jump. For the upper body, kinetic energy can be stored and released in exercises such as Marine Corps push-ups, in which trainees clap their hands between repetitions. Verkhoshansky applied the term *shock training* to the training system that used such exercises. One characteristic of shock training is a brief transition phase between landing and takeoff.

How effective is shock training? In the '60s a dozen of Verkhoshansky's athletes reached the prestigious level of "Master of Sport." One of these masters was Boris Zubov, who in 1964 broke Soviet and European records in the sprint events.

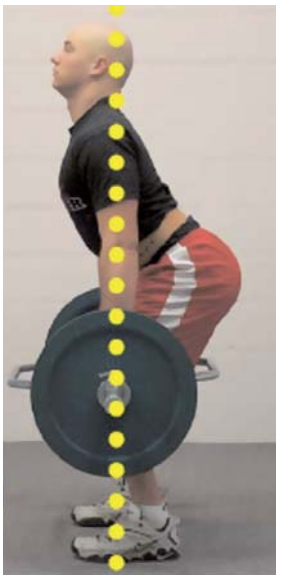
Verkhoshansky eventually decided to change his focus to teaching and research. When Verkhoshansky's accomplishments reached the US, the term *plyometric,* instead of shock training, was used to describe his training methods. This was a mistake, because in the US the term plyometric training described any activity that involved a rapid stretching of a muscle (eccentric phase) immediately followed by a rapid shortening of that muscle (concentric phase). As such, squats and even jumping rope were considered plyometric. Now we know better.

## Shock Training with Squat Jumps

A barbell squat jump involves placing a barbell on your shoulders, as you would during a back squat, and then performing jumps. The late Dr. Mel Siff, a colleague of mine who co-authored with Dr. Verkhoshansky the exercise textbook *Supertraining*, was a sport scientist who promoted two additional types of squat jumps.

Siff promoted these two types of jumps because he believed that many US athletes were relatively weak eccentrically, which means they had a difficult time controlling the disruptive forces that occur to the body during the landing phase of jumping activities. If an athlete's knees buckle inward when they land after a jump, this could indicate a lack of eccentric strength. Also, being weak eccentrically means that it takes longer for an athlete to stabilize their body not just during jumping activities but also in agility movements that involve rapid changes of direction.

With the first type of squat jump,



The hex bar design allows the weight to be in alignment with the center of mass of the body, as indicated here by what BFS calls the *power line*.

you rise up on your toes, drop rapidly into a quarter (or even a parallel) squat, and repeat. This is the type of squat jump that can be performed by beginners or as a warm-up before more advanced shock training exercises. With the second type of squat jump you simply jump as high as possible, land in a quarter squat and immediately rebound.

The focus in both these exercises is a rapid eccentric contraction and a brief transition phase. As such, heavy weights are not necessary. Often only the weight of the empty standard Olympic bar (45 pounds) or of a lighter exercise bar is necessary.

Although it was not part of a scientific study, several years ago I worked with a high school girls weightlifting class in Salt Lake City used these jumps as part of their conditioning. A general workout consisted of performing 12-15 jumps for two sets, twice a week. Using a BFS Just Jump force platform, 11 of the girls in this class recorded vertical jumps of 23 inches or more, with one girl reaching 27.1. Although these girls also performed squats and cleans, such exceptional results suggest that these jumps were effective. It should also be noted that rather than using straight bars, the girls performed the jumps with hex bars.

The hex bar is a hexagonal-shaped barbell that enables the user to perform deadlifts while standing inside the bar; the handgrips are placed near the inside collars of the bar. One of the benefits of this type of bar is that the center of the barbell is in line with the hips – what we at BFS like to call the "power line." In contrast, with a straight bar deadlift the legs get in the way, and thus the resistance is applied farther from the individual's center of mass. This difference in design places less stress on the lower back and more stress on the legs. The advantages of the hex bar design were confirmed by the following study: "A Biomechanical Analysis of Straight and Hexagonal Barbell Deadlifts Using Submaximal Loads." Paul A. Swinton, Arthur Stewart, Ioannis Agouris, Justin W. L. Keogh, and Ray Lloyd. *Journal of Strength and Conditioning Research*. (2011 July). 25(7); 2000-2009.

Additionally, research shows that the hex bar is a superior method of performing not just deadlifts but also squat jumps. The same researchers who did the previously mentioned hex bar deadlift study also did an eight-week study comparing straight bar squat jumps (SVJ) to hex bar squat jumps. The study was submitted to the *Journal of Strength and Conditioning Research*, and when published it will be entitled "Effect of Load Positioning on the Kinematics and Kinetics of Weighted Vertical Jumps."

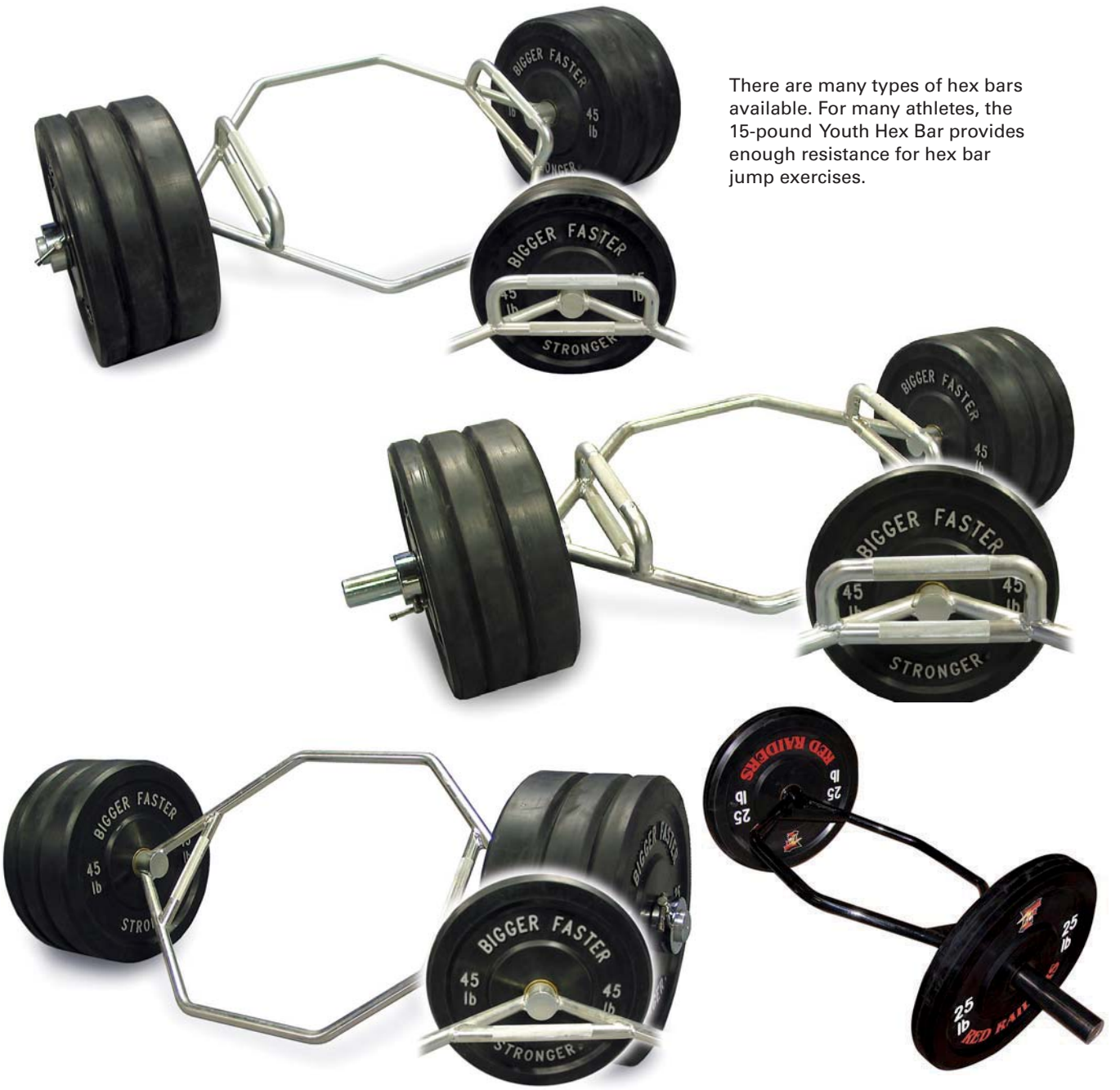
The authors reported that one of the advantages of using hex bars was greater stability, especially when compared to dumbbells (which, by the way, can bang against the athletes' thighs and cause bruising). The researchers also found that by using

Shown is the techniques used in the study on squat jumps, the first two photos showing the jump performed with a straight barbell, and the second with a hex bar.

a hexagonal barbell rather than a straight bar "…the athlete can jump higher and generate greater force, power, velocity and rate of force development."

The researchers believe that the primary reason for the improvements was that the biomechanics of hex bar jumps more closely resemble the type of jumping that most frequently occurs in sports. Here is how they explain it: "When the barbell is positioned across the shoulder to perform the SBJ the potential to create large resistance moment arms may cause athletes to divert from their normal unloaded jump technique and adopt a less effective, more vertical squatting motion." The researchers also found that the hex bar creates less "resistive torque on the lower-body joints," which "may have enabled athletes to accelerate the load more effectively."

BFS discovered the benefits of the hex bar more than 15 years ago, and we have been promoting it as a replacement for the straight bar deadlift. Now there is peer-reviewed research that confirms not only that using a hex bar is a better way to deadlift to improve overall strength but also that performing squat jumps with a hex bar is a superior training tool to improve agility and jumping power. Isn't it time you invested in a hex bar? BFS




There are many types of hex bars available. For many athletes, the 15-pound Youth Hex Bar provides enough resistance for hex bar jump exercises.

# The Forgotten Secret to *Jumping Power*

## How shock training can jump-start your athletes

BY **KIM GOSS**

For more than 32 years BFS has promoted plyometrics for all levels of athletes. The reason is that plyometrics is a powerful training tool that can significantly improve speed, power and overall athleticism. Unfortunately, many athletes don't see these results from plyometrics, and some have even become injured from such training. What's going on?

The major problem with many coaches who prescribe plyometrics to their athletes is that they underestimate the intensity level of this type of activity. For example, last year I tested an elite female athlete just before she participated in a summer conditioning program. That workout schedule involved performing plyometrics up to five days a week, with some workouts requiring her to perform hundreds of repetitions in various forms of jumping. Compare that to the plyometrics component in the BFS program, which has athletes perform box jumping for about 10 minutes twice a week.

By the end of this program this young women's vertical jump had decreased by three inches and she had developed overuse injuries in both knees that required numerous physical therapy treatments. The lesson to be learned from this unfortunate experience is not only that better results can be achieved with very brief sessions of plyometrics but also that overdoing plyometrics can decrease performance and increase the risk of injury.

### Learning from the Russians

One reason for the confusion about plyometrics is that it has been difficult to absorb practical information from the classic research published in this area. For example, Soviet sport scientist Yuri Verkhoshansky is considered the founder of modern-day plyometrics. Here is a passage from his textbook *Programming and Organization of Training:*

"Indispensable conditions of training organization which provide extensive and relatively prolonged disturbance of homeostasis, are the precise dosage of loading, as well as rehabilitation stages necessary for triggering a compensatory reaction, elimination of the hetero-chronicalness phenomenon in the dynamics of the various functional indicators and stabilization of the organism at the new functional level." *Say what?*

To be fair, much of Verkhoshansky's work was being translated from Russian by college students or other

individuals with little background in sport training. Fortunately, in the early '90s Verkhoshansky decided to work with Mel Siff, PhD, a sports scientist from South Africa who later moved to the US. Siff was able to translate Verkhoshansky's work on plyometrics so that it could be better understood by non-sport scientists.

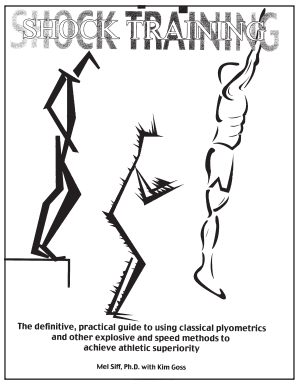
## The Science of Shock Training

I first met Dr. Siff in the late '80s when I was a strength coach at the Air Force Academy. We became close friends, and I wrote numerous articles about Siff's training ideas and consulted with him on many projects I had been working on. We eventually decided to write a series of books that would focus on the practical aspects of his and Verkhoshansky's training ideas; tragically, Dr. Siff died unexpectedly in 2003 before we could complete them. One of the books that we had made considerable progress on was called *Shock Training.* We decided on this title because the term *plyometrics* had been so maligned in the US.

Siff says that shock training is "a method of mechanical shock stimulation that forces the muscles to produce as much tension as rapidly as possible. It is characterized by an intense muscular contraction that is preceded by a relaxed state." Jumping rope does not produce a high-enough level of muscle tension to be classified as a shock training exercise; and although the squat produces a high level of muscle tension, there is no mechanical shock stimulation. Thus, although the squat is a great exercise, it would be more appropriately called "preparatory" exercise for shock training.

Stepping off a box (not jumping, as the thigh muscles must be relaxed during the fall) and immediately rebounding upward upon landing is considered an example of a shock training exercise for the lower body. This exercise is commonly called a *depth jump,* and it is included in the BFS box jumping program. Performing Marine Corps push-ups, in which you clap your hands, land and then immediately perform another repetition, is an example of shock training for the upper body. This exercise is commonly called a *plyometric push-up.*

Verkhoshansky's research has revealed that shock training, used intelligently, is the most effective type of plyometrics. In one 12-week study Verkhoshansky divided track-and-field athletes into two groups. The first group performed 1,472 low- and medium-level plyometric activities, including squats. The other group performed 475 jumps using the shock training method. Although the shock training group performed a third less work, these athletes showed statistically significantly greater improvement in reactive ability than the group using traditional methods.




At left, sport scientists Dr. Mel Siff (standing) and Yuri Verkhoshansky were pioneers in plyometric training. Prior to his death, Dr. Siff was working on a book about shock training, a form of plyometric training that is described in this article.

Shock training is a powerful tool for athletic training, but because it places such high levels of tension on the muscles and stress on the nervous system, it must be approached with caution. In this regard, Siff believed that many US athletes were relatively weak eccentrically, which means they had a difficult time controlling the disrupted forces that occur to the body during the landing phase of jumping. In fact, what I found when testing gymnasts using the BFS Just Jump force plate is that often they can jump as high without a step as with a step. I believe this phenomenon occurs because in their sport there is little eccentric loading other than the athlete's bodyweight.

Accurate testing of the vertical jump can be accomplished easily and accurately with the BFS Just Jump testing system.

In addition to reinforcing how important it is for all athletes to perform squats, which train the muscles eccentrically as the athletes bend their legs, Siff introduced to me several drills that will help athletes prepare for the more advanced shock training exercises. I'd like to share a few of these with you.

## Shock Training with Squat Jumps

The exercises Siff taught me involve a rapid deceleration of eccentric movement, as opposed to the slow eccentric movements recommended with most weight training exercises. The drop snatch, in

which an athlete places a barbell behind the neck and suddenly drops into a full-squat position, is one such movement. Another is the squat jump, which is best performed with a Hex bar.

A Hex bar is a type of barbell that has a hexagonal shape that allows you to stand inside the apparatus as you exercise. Rather than having your hands in front of you when you perform exercises such as deadlifts, with the Hex bar your hands are at your sides, a design that encourages you to stay more upright as you exercise and keep your shoulders back. This is a great advantage, because when you perform squat jumps with a barbell, there is a tendency to lean forward as you fatigue. In contrast, with the Hex bar that momentum results in a shoulder shrug, giving your traps a good workout. Siff would always point out that when athletes jump with a barbell on the shoulders, as was often performed by Russian athletes, the bar separates from the body and crashes on the shoulders, placing considerable compression forces on the spine.

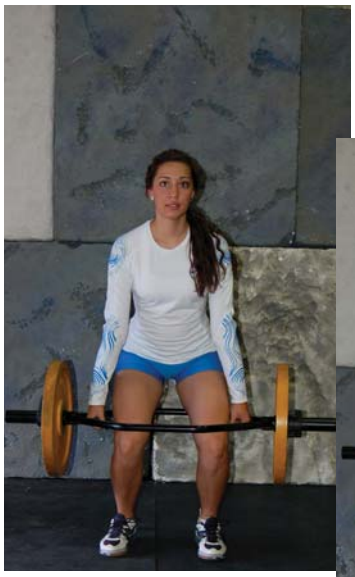
Depth jumps and plyometric push-ups are forces of plyometrics Dr. Mel Siff referred to as shock training, which are intense forms of training that develop power.

Siff taught me two types of squat jumps. In one type of squat jump, you rise up on your toes, drop rapidly into a quarter (or even a parallel) squat, and repeat. This is the type of squat jump that can be performed by beginners or as a warm-up before more-advanced shock training exercises. The second type of squat jump is to simply jump as high as possible, land in a quarter squat, and immediately rebound. Examples of these exercises are provided in the photos accompanying this article.

The focus in both these exercises is a rapid eccentric contraction and a brief transition phase. As such, heavy weights are not necessary. For my high school girls' weight training class, I often use no more than the weight of the empty Hex

## Hex Bar Squat Jumps

Hex bar squat jumps are a great shock training exercise to develop eccentric strength, which is an important aspect of athletic performance.



Squat Jump, *Beginner*

Squat Jump, *Advanced*

bar (45 pounds) or the Youth Hex bar (15 pounds). As a comparison, Siff told me that Serge Reding, the great Belgian superheavyweight weightlifter who was the first man to snatch 400 pounds, could jump 16 inches off the ground while holding a barbell that weighed 286 pounds!

It would be difficult to prescribe exact sets and reps, but for high school athletes one effective protocol I've used is a warm-up of one set of 12-15 reps without leaving the ground, followed by two sets of 8-10 reps leaving the ground – that's all! At most, such workouts could be performed twice a week, but advanced athletes would need to cease such high-level workouts about 10 days before major competitions to peak properly.

I used squat jumps last year with one 14-year-old Level 10 gymnast who had a 22-inch standing vertical jump, both without and with a step. In two months of appropriate plyometric training she added 3.7 inches to her standing vertical jump and added 4.2 inches to her vertical jump with a step. Again, this was an elite athlete who already had an exceptional vertical jump. I also introduced this training to a high school volleyball team and noted great improvements in both types of jumps just a few weeks after introducing squat jumps; the volleyball coach told me recently that over the course of the semester her best athlete added 8 inches to her vertical jump with a step! Likewise, I had good success with such training methods when I trained figure skaters at my private gym in Dallas, and these results have encouraged me to continue using shock training with my athletes.

Plyometrics are included in the Tuesday and Thursday workouts of the BFS program, but often I've found that with many coaches I've interviewed they only perform the off-season weight training workouts with their athletes due to time restraints. This is unfortunate, because to be effective, plyometric training should be performed year-round – and again, *the BFS box jumping program takes only 20 minutes a week!* But for those programs that simply can't fit in time for plyometrics, performing some Hex bar squats jumps as an auxiliary exercise could be a practical alternative to keeping athletes plyometrically fit.

I regret not finishing that series of books during Dr. Mel Siff's lifetime, but I hope that this article will give you a clearer picture of what shock training is and how Hex bar squat jumps can be a valuable auxiliary exercise for athletes. I've found this training method invaluable for my athletes, and I also urge you to use it to great advantage. BFS

Lusia Angilau plays basketball and volleyball at Hunter High School in Salt Lake City, and this year her club team competed in the Junior National Championships in volleyball. Lusia has a 27.1" vertical jump and is also a promising weightlifter.