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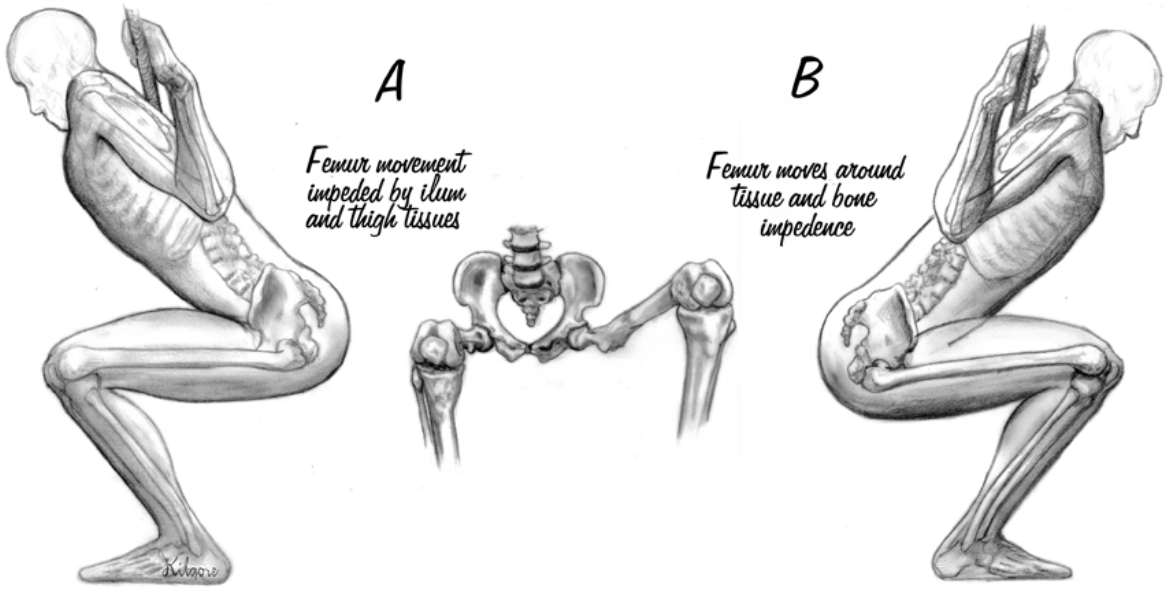
You don't know Squat without an "Active Hip"

It's powerful, safe and easy to do:
Aim toes out, push knees to the side, arch the lower back, and blast off.

Mark Rippetoe and Dr. Stef Bradford

Illustration by Lon Kilgore



The anatomical details of the skeletal aspects of "hip impingement."

The term "Active Shoulder" (CrossFit Journal Sept. 2005 (37):13). has been used to quite effectively describe the proper motion of an overhead press—in short, when the shoulder girdle muscles, starting with a concentric contraction of the traps, end up supporting the weight in a way that places a balanced load over the scapulae, thereby protecting the soft tissue of the joint from impingement. Since I find that concept of the active shoulder very useful in teaching the press and its variations, as well as the snatch and the overhead squat, it always made me wonder: Is there was an equivalent concept available for cleaning up the problems associated with the squat?

Well, it turns out that there is. And just for the sake of making a nice little pattern, I call it the "Active Hip."

When we squat, the standard range of motion criterion for the exercise is "below parallel," defined as the hip joint identified at the apex of the hip angle (the "corner" in your shorts over the hip) as it drops below the knee (the top of the patella). Most people that have trouble with the squat are having trouble getting good depth while keeping their low back from rounding. Pretty much anybody can get deep if they allow the lumbar spine to relax into flexion, a phenomenon known in some circles as "butt wink." But I have found that almost every single human being on this planet can squat below parallel with pretty good back position if their stance is correct and if they simply shove their knees out to the sides at the bottom. This is because a type of impingement occurs at the bottom of the squat that is relieved by shoving out the knees, and at the same time an improvement occurs in the way the hips work.

Stef, who is much smarter than I am, occasionally walks up to me and says things that cannot be ignored. That's not because she says them in a clear, strong voice, but because they make such perfect sense that you have to say to yourself, "Why is it that *she* said this before I did? Am I that *dull*? This is so damned obvious that I must now begin to question my ability to reason and observe. Maybe I'm drinking too much, or not sleeping enough, or something..."

That brings me to the day that Stef walked up to me one day and made the following observation: "You know that the femur impinges on the hip pointer at the bottom of the squat if the knees aren't out of the way, in the same way that the acromion process of the scapula impinges on the humerus in the press if the traps aren't shrugged, don't you?" She said it like I was a moron for not having said it first. I had to agree.

Toes and Knees Angled Out = Good;
Straight Ahead = Bad.

If you stand with your heels at shoulder-width apart and point your toes out at about 30 degrees, squat down, and keep your thighs parallel to your feet, that's perfect: As your hip angle closes and your thighs approach your torso, your femurs will track to a position that is *outside* of the anterior superior iliac spine (AIS)—the hip pointer that you feel right below your waistline.

However, if you point your toes straight forward and let your knees follow your toes, or even if you point your toes out but still let your knees cave in toward the middle when you squat, you'll run into problems. As you squat down, your femur will approach the AIS as you approach the bottom. If your thighs jam into your belly, it tends to trap any soft-tissue structures that may be in the area between the thigh and the hip pointer. If you have a big gut (that famous 60 pounds of undigested red meat, perhaps?), or big thighs, or a lot of clothes on, this will keep you from obtaining a below-parallel squat.

And if you try to continue to drop down to get better depth, it will happen at the expense of a rounded lower back, since the hip angle cannot become more acute if the femur is trapped against the ASIS. If the pelvis—which is supposed to be locked into the lordotic curve with the lumbar vertebrae—can't tilt forward to maintain this position because it rams into an obstruction formed by the femur, the only way to keep going deeper is to round the low back into lumbar flexion. The obstruction occurs before the bones actually touch, of course, since the hip flexor origins lie in between. So everybody will experience this phenomenon to one degree or another, and everybody who cannot get below parallel with an arched low back has this problem.

If you're having depth problems, shoving the knees out fixes it so often that it is waste of time to do anything else first.

A comparison of the effects of the active hip position and the knees-forward position on the lumbar extension of 2 people at the bottom of the full squat.

Most people won't do the job of keeping their knees out unless they're coached to do so, often and loudly. The knees want to track more medially than this because of the tension on the inside of the femurs produced by the adductors—the groin muscles. These five muscles (the adductor magnus, adductor brevis, adductor longus, pectineus, and gracilis) attach at various points along the medial and posterior aspect of the femur, and on the ischium and pubis of the pelvis. Tension is produced between these two bones as you squat down and keep your knees out; this is eccentric contraction for these muscles, since they lengthen as the femur maintains its position parallel to the feet. As you come up out of the squat, the distance between the inside of the femur and the medial pelvis shortens as the hip angle opens up; the concentric contraction of the adductor muscles thus produces hip extension.

Visualize this by imagining a point at the end of the inside of your thigh down by your knee, and another point on your "seat bone," under your butt and behind your crotch. These points represent the attachments of the biggest adductor, the *magnus*. Since your back is locked in extension by your spinal erector muscles, and the back of your pelvis is locked in position along the line of your back by these same muscles, as you squat down and make your back more horizontal your seat bones rotate back and away from your knees. And if your knees stay in position, pointed in the same direction as your feet—out at about 30 degrees—the distance between the point on the inside of your thigh and your seat bone increases. And if this distance increases as you go down and decreases as you come up, the contraction of the muscles that got longer on the way down makes the coming-up part happen. This is how the adductor muscles function in a correctly performed squat, and why they are considered hip extensors, along with the glutes and hamstrings as part of the posterior chain.

Since the adductors tend to pull the knees in, what keeps them out when you use your hips correctly? If ***ad***-duction of the thigh means pulling the distal end of the femur toward the midline of the body, it seems like ***ab***-duction would be the movement used to keep them out, and that the abductors would be the muscles that did this. But the abductors consist of the tensor fascia latae (the TFL, a small muscle that connects the hip at the anterior iliac crest to the lower leg), plus the gluteus medius and gluteus minimus. Together they create hip abduction if you raise your leg out to the side away from your body. The trouble is that nobody actually does this except in biomechanics class.

Therefore, it would make more sense to assign the task of shoving out the knees to the external rotators of the hip. External rotation occurs when you make your right femur rotate clockwise and your left femur rotate counterclockwise, as when you stand up and rotate your toes away from each other balanced on your heels. The action of rotating the femurs out is what actually occurs when you drive your knees out on the way down to the bottom of the squat. Prove this to yourself by sitting in a chair and making the same muscle action on your femur as you would pointing out your toes while standing up. There are at least nine muscles that perform this function (the gluteus medius, minimus, and maximus; adductor minimus; quadratus femoris; inferior gemellus; obturator internus; superior gemellus, and piriformis), which is critical to stabilizing gait mechanics through the range of motion of the stride.

Using the above nine muscles to set the knees in a position parallel to the feet makes all kinds of sense when you consider that they are in an effective position to do it and the TFL is not (the minimus and medius are external rotators, anyway). (And while we're using parentheses, Nautilus had an extremely silly machine that exercised abduction and adduction of the hips in isolation, of course, from the rest of the hip function—cleverly designed, but utterly irrelevant to human movement.) So shoving the knees out of the way on the way down and keeping them there so that the adductors can do their job is accomplished by hip external rotation, and forms an important part of the active hip concept.

Explode up with the Stretch Reflex and an Arched Lower Back

When you intentionally shove your knees to the outside as you come down into the bottom of the squat, you not only get the femurs away from the ASIS; you allow the adductors to stretch tighter and position them to more effectively contract as they reach the limit of their extensibility. A tight, stretched muscle contracts harder than a looser, shorter muscle, because the stretch tells the neuromuscular system that a contraction is about to follow; a more efficient firing of more contractile units always happens when preceded by a stretch. This *stretch reflex* is an integral part of all explosive muscle contraction, and better athletes are very good at making it happen.

When we squat, the external rotators of the hip position the femur so that the adductors can participate with the hamstrings in the bounce. So the whole hip musculature contributes to squatting efficiency—*if you shove your knees out.*

The bounce is the stretch reflex produced in the tightened posterior chain that you should feel when you stretch out the hamstrings and adductors at the bottom. It is an important part of the squat, both when loaded with a heavy weight and when unloaded as an "air" squat, when a rapid turnaround is important for timed exercises. When you use an *active hip*—deliberately keeping the knees out, or actively pushing them outward into a position parallel to the pointed-out toes with your pelvis locked in line with your arched lumbar spine—you make your squat depth more easily obtainable and your hip drive out of the bottom faster and more powerful.

The limit of the adductors' and hamstrings' extensibility will almost always be below parallel, as defined earlier. Some people lack sufficient extensibility in the posterior chain muscles, and some people have tight joint capsule ligaments. But more than stretching, people merely need the correct stance, the correct knee position outside the ASIS, and a loud reminder to keep their knees out. The weighted squat has few superiors in the realm of things that go *stretch,* and what little there usually is to stretch can most often be done within a few sets of weighted squats that incorporate an active hip.

"My good collegiate weightlifter and one of my older members both recently became the recipients of my head popping out of my ass one day, when it occurred to me that maybe they needed a refresher on arching the low back. "

It has recently come to my attention that a relatively high percentage of people, many more than I had previously thought, have no idea what the hell their low back is doing at any given time. My good collegiate weightlifter and one of my older members both recently became the recipients of my head popping out of my ass one day, when it occurred to me that maybe they needed a refresher on arching the low back. As it turns out, neither of them had ever consciously contracted their lumbar erectors, and didn't actually know how to do it. They had been relying on ligament tension and general trunk tightness, fine for very light weights but really a handicap at work set loads. If the lumbar spine and the pelvis do not stay perfectly rigid in what could be called "pelvic lock," force transfer is not as efficient up the spine, posterior chain rebound is soft, and back safety may ultimately suffer. My weightlifter subsequently did four PRs at a meet two weeks later; my other member was merely happy. We now include learning this simple movement very early in all Basic Barbell certs, where we usually find that about 15% of the people in attendance don't have voluntary control of their lumbar muscles.

Summary: Go Deep and Move the thighs

The concept of the *active hip* is best understood as the use of an actively locked lumbar extension and actively shoved-out knees, which results in a below-parallel squat that incorporates a stretch reflex using all the muscles of the posterior chain in the most optimal way possible. The active hip gets the thighs out of the way of the pelvis so that good depth can be more easily obtained. At the same time, it makes the squat stronger and more powerful because of the more effective use of more muscles over a wider range of motion.

The active-hip concept is also applicable in movements that don't elicit a stretch reflex. If a hip extension is involved in the movement, as it most certainly is with all pulls from the floor, the lower back obviously needs to be in pelvic lock and hard extension, but what is less obvious is the adductor and external rotator component. If the knees-out position can tighten up the adductors, they can function more effectively as hip extensors, and since hip extension is involved in any pull, a knees-out position can improve their participation in the pull. Since the range of motion of the hips in a pull from the floor is relatively smaller than that of the squat, their direct contribution is low, but any external rotation engages the adductors in a supportive/hip tightening role. This allows more precise control of movement at the hip (an effect that's easy to feel in the dip-and-drive of the jerk) and more effective transfer of force by the hip extensors that directly contribute to moving the load. Olympic weightlifters often employ this knees-out starting position to fix problems off the floor and allow for a better back angle.

Another thing that affects pulling from a more knees-out position is the effective shortening of the distance between the bar and the hips when the knees

are shoved out of the way a little. This modification of the effective length of the thigh makes a more vertical bar path easier to obtain off the floor. But even when the stance is relatively narrow or the hip angle relatively open, a little external rotation of the femur alters the balance of muscle action around at the hip in a positive way, helping with a more effective hip extension off the floor.

So next time you squat, whether loaded with a PR set of 5 or doing Tabatas, remember the concept of the active hip: just get your knees out of the way and lock your lower back into extension. It's as useful to your squatting as shrugging your traps is to your pressing.

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Coaches Mark Rippetoe and Greg Glassman at the CrossFit Certification Seminar in Santa Cruz, CA February 10, 2006.

About The Authors

Mark Rippetoe *and his buddy Phil do most of their squatting at his gym, Wichita Falls Athletic Club/CrossFit Wichita Falls. Rip has 30 years of experience in the fitness industry and 10 years as a competitive powerlifter. He has published articles in the* ***Strength and Conditioning Journal****, is a regular contributor to the CrossFit Journal, and is the author of the books* ***Starting Strength: Basic Barbell Training****,* ***Practical Programming for Strength Training****, and* ***Strong Enough? Thoughts from Thirty Years of Barbell Training****.*

Stef Bradford *has a PhD in pharmacology from Duke University. She is a competitive Olympic lifter and the real brains behind The Aasgaard Company.*