The Front Squat / Back Squat Debate  
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Part 2: The comparison, front squat vs. back squat

This article builds off of the previous article where I outlined the technique requirements of a good squat motion and the designation of first, second and third level classification of exercises.

Now, rather than go on and on about the squats, let’s just look at the videos of an athlete I took at our facility a couple for years ago. Pictures, and video, can be worth a thousand words.

Front Squat

http://www.youtube.com/watch?v=7aETPt7wvI8

Back Squat

http://www.youtube.com/watch?v=W3loyGytJhc

Below are images I have taken from these two videos that I use to demonstrate to our staff the difference between loading the front squat and back squat exercises. Specifically, I want my staff to see what loading with two different bar positions does to the athlete in terms of body position, limb motion and the athlete’s posture, specifically at the bottom of each lift.

The images are of a professional baseball pitcher; 24 yrs old, 182lbs body weight with 8+ years training experience with myself. The maximum lift for him in the TB Deadlift is a 4RM of 340lbs, giving him a projected 1RM of 372lbs.

This athlete is a decently strong individual, able to lift over double his own body weight in the TB Deadlift and when I took the videos and photos of each lift, I was confident that his experience would allow the comparison of these two bar positions to be as unbiased as possible. Obviously the lift he normally performs would be a more comfortable movement for him to lift heavier in, but the motion of the squat itself was what I was trying to illustrate for our staff, not the amount of weight that he could lift.

The weights used in the photos were:

- Front Squat 225lbs
- Back Squat 275lbs

These weights represent an approximate ratio of 82% of front squat to back squat loading. The lifts were not competitive lifts for this athlete, but enough of a load to challenge him on each repetition, most likely around a 6 to 8RM load for each exercise.
Joint Angle/Body Alignment Illustrations

In the first photo, the front squat is illustrated with the angle calculated for the hip and ankle motion measured at the bottom of the squat motion.

The second photo is the same measurements but for the back squat.

The third photo is a measurement of the knee joint flexion at the bottom of the front squat motion.
Fourth is the same measurement but for the back squat.

The fifth image is the alignment of the femur, measuring the true depth of the pelvis into the squat motion based on the angle the femur makes relative to a vertical axis.
The sixth image is the angle of the femur in a back squat relative to a vertical axis.

The seventh image is a comparison of the angle of the posterior chain (from the pelvis to the lower cervical region) to a vertical axis in the front squat.
The eighth photo is a similar measurement of the posterior chain relative to a vertical axis but on an image of the back squat.

Here is a rough outline of the sacrum, lumbar and thoracic vertebrae alignment in the front squat.
Here is the same attempt in the back squat.
Summary:

<table>
<thead>
<tr>
<th>Joint Motion / Alignment</th>
<th>Front Squat</th>
<th>Back Squat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip Flexion</td>
<td>56.1°</td>
<td>43.8°</td>
</tr>
<tr>
<td>Ankle Dorsiflexion</td>
<td>69.2°</td>
<td>70.4°</td>
</tr>
<tr>
<td>Knee Flexion</td>
<td>63.4°</td>
<td>69.0°</td>
</tr>
<tr>
<td>Femur to a Vertical Axis</td>
<td>89.6°</td>
<td>94.5°</td>
</tr>
<tr>
<td>Posterior Chain to a Vertical Axis</td>
<td>33.9°</td>
<td>52.6°</td>
</tr>
</tbody>
</table>

We can see from the images and the numbers:
- During a front squat the athlete creates more motion from the hip joint than in the knee joint.
- The ankle motion was pretty much the same in both lifts.
- The back squat requires the athlete to move more from the knee joint.
- The athlete is able to sit into a thighs parallel position much easier in the front squat, achieving considerably more range in the squat movement itself.
- The posterior chain is “pushed” forward over 18° more in the back squat by the load of the bar. Conversely, you could say the front squat forces the lifter to “pull” the upper body back 18° more than the back squat against the resistance of the load on the bar. In either case, the lifter is attempting to keep the weight on the bar overtop of their foot positioning.

One thing to keep in mind: For this athlete, he commented that in the bottom position he felt he had squatted to equal depth in both lifts. Also, he said it felt like he had almost the same torso positioning in both of these lifts that we filmed.

The perception of this athlete was there really was very little proprioceptive difference in feeling the bottom position of each lift, though we can see from the images there is considerable difference in the actual joint angles and body positions achieved when these lifts are analyzed using measurements of the limb positions and the resultant joint motion.

So where are we in this discussion? For me, I see two lifts which have very different starting motions, very distinct patterns of movement into and out of the squat motion and very distinct body positions at the bottom of the lift.

Initiation of Motion

For athletes, the performance of the front squat has a certain guarantee of success right from the beginning of motion. This guarantee is rooted in the beginnings of the movement itself. Just based on the initial bar positioning, the initiation of motion into the squat is to counteract the forward weight of the bar, thus a posterior weight shift of the hip complex is required. So the fundamental movement required for a correct squat motion, posterior translation of the hip complex, is easily assumed by the athlete performing a front squat as the hip complex acts as a counterbalance to the weight of the front bar load.

In contrast, the back loaded position has the load of the bar positioned towards the posterior aspect of the athlete’s base of support, their feet. With the load positioned over the athletes’ heels, any movement of the hip complex posteriorly during the squat must be countered with
an anterior shift of the athlete’s weight forward. This lack of posterior options forces the athlete to instead break the straight leg starting position by flexing the knees first before the hips, resulting in a forward shift of body weight as the back loaded squat begins.

If the athlete does not break at the knees first but does attempt a posterior hip shift, the strategy then shifts to an anterior translation of the upper body. This compensation is an attempt to keep the weight of the bar over top of the feet. The anterior tilt of the upper body places a significant load on the ability of the athlete to maintain an extended posture with their back. This additional load on the musculature of the back itself grows substantially as the anterior tilt of the upper body increases.

The initial success of the front squat is not so easy to replicate in the back squat. Where the front squat rewards hip initiated motion, the back squat promotes knee and upper body movement, forcing the athlete to work hard to achieve hip joint based movement. Even in the experienced lifter, the demands of starting a perfect back squat technique are harder to achieve and maintain when significant loads are applied to the athlete.

Thus, the front squat rewards the initial backward translation of the pelvis, keeping the weight overtop of the base of support and the athlete initiating motion in the proper posterior hip shift movement pattern. The back squat does not reward this initiation of movement at all.

**Mid-Squat Technique**

Now if we look at the movements in the middle of the squat itself, during the front squat if an athlete does mistakenly move into a knee flexion movement pattern, the load of the bar quickly moves anterior of the athlete’s base of support (their forefoot and toes) and they instinctively have to thrust the pelvis posteriorly to correct this improper positioning. Also, if the athlete loses the straight back posture, the bar becomes too heavy for the upper body to support as the bar weight continues forward. The bar drops forward off the shoulders, ending the lift attempt. The front squat ends up being self-correcting just due to the nature of the lift.

For the back squat, too often the tendency of the athlete is to allow the upper body to fall forward during the squat movement. Regardless of your interpretation of the squat motion itself, if the upper body is moving forward, the center of gravity of the athlete is moving forward due to the back loaded position and thus the anterior slide of the knees cannot be prevented within the legs alone. Thus, the resultant excessive knee joint motion, as seen in the photos above, is explained. The self-correcting nature of the front loaded squat is not present in the back loaded movement.

The pattern of motion I usually see in the performance of the back squat is for the athlete to break at the knees first, with the hips tucked under the rib cage and no appreciable posterior shift of the pelvis as the downward movement begins. If there is a posterior hip shift, it is accompanied by a significant anterior tilt of the upper body, whether by way of hip flexion or the lumbar spine flexing.

Either way, most back squats I see in a training situation are simply a back loaded deadlift. The athlete loses the posterior and downward motion of the pelvis and instead allows the head to drop forward towards the floor. Then, the lift up is accomplished more as an upper body
deadlift against the resistance of the bar than a true concentric squat movement. These are terrible movement patterns that require more strength and joint motion from the structures of the back than is required from the legs.

In the third article of the series, we will continue examining the front and back squat movements, focusing on the bottom portion of the lifts as well as my interpretation of an athlete’s safety and performance in each of these lifts.