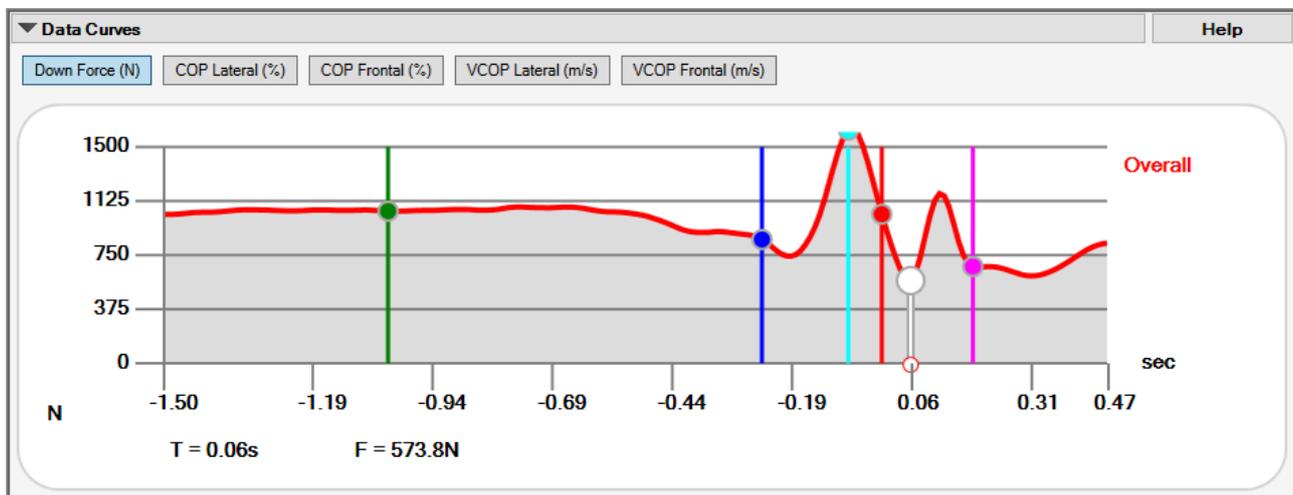




## BalanceLab 3 Ultimate – New Data Curves

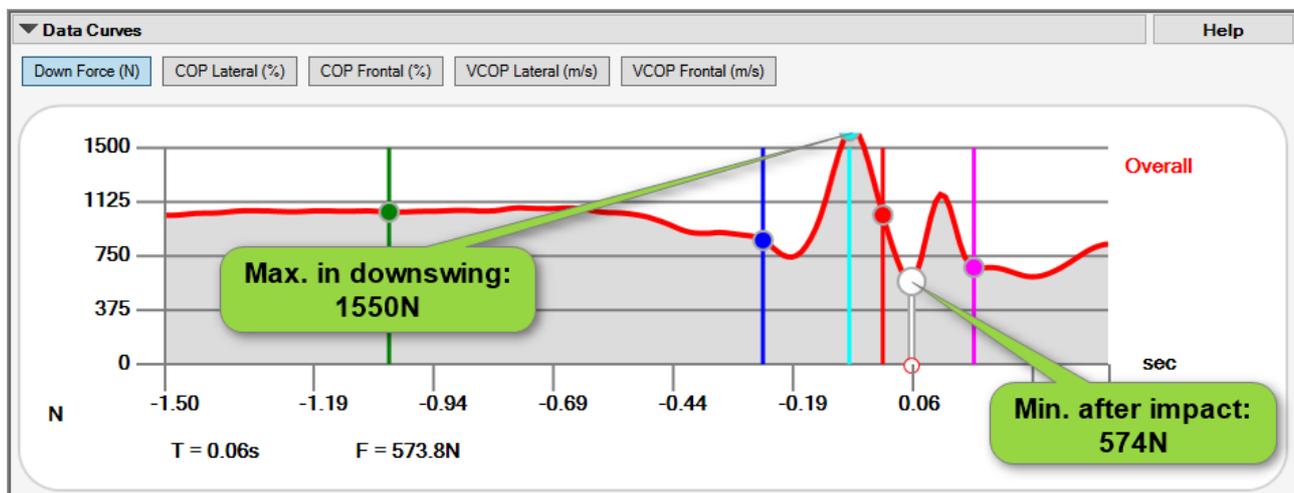


Parameter	Short Description
<a href="#">Down Force</a>	The data curve vs. time of the overall vertical downforce that is exerted to the pressure plate during the swing
<a href="#">COP lateral</a>	The data curve vs. time of the COP in the lateral (left / right) direction. The COP lateral curve data is calculated in percent of weight distribution.
<a href="#">COP frontal</a>	The data curve vs. time of the COP in the frontal (heel/toe) direction. The COP frontal curve data is calculated in percent of weight distribution.
<a href="#">VCOP lateral</a>	The data curve vs. time of the speed of the COP movement in the lateral (right / left) direction. The COP speed corresponds to the change of the COP position on the force plate.
<a href="#">VCOP frontal</a>	The data curve vs. time of the speed of the COP movement in the frontal (heel / toe) direction. The COP speed corresponds to the change of the COP position on the force plate.

## 1. Down Force

The **Down Force** data curve vs. time represents the overall vertical downforce that is exerted to the pressure plate during the swing. The total downforce is calculated by summing up the pressure (force) data of all sensors.

Depending on the movement of the player the downforce can vary considerably. Around Start in the *Setup* position (green line) the downforce is relatively stable. While approaching the top of backswing (blue line) the downforce will be slightly reduced due to the upwards movement of the club. Shortly after starting into the downswing the downforce will increase as the club is now moving down. Additionally most players will squeeze off the ground with the right foot which will further increase downforce during downswing and will result in a downforce peak roughly around *Delivery* (light blue line). As the body will now move up to impact the downforce is decreasing again and will result in a downforce minimum, which normally is shortly after *Impact* (red line). Moving up through impact can help to significantly increase the clubhead speed (for the driver).



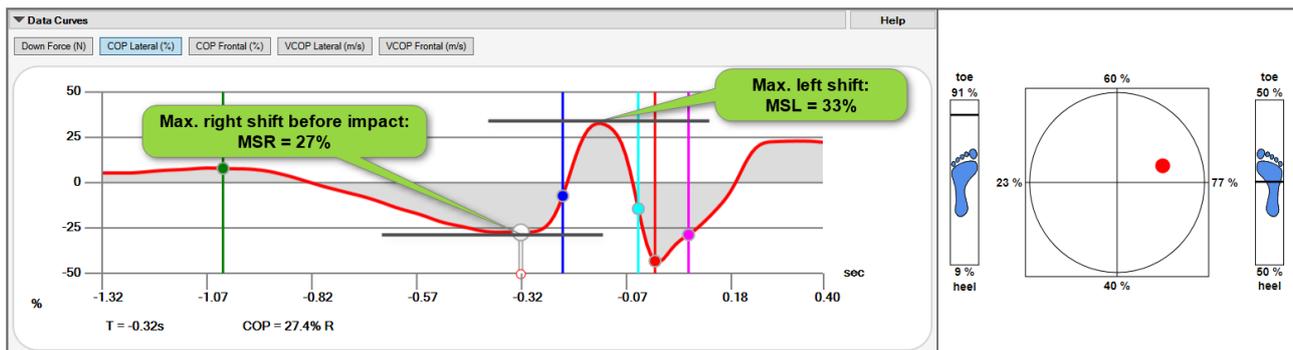
The scale at the left is indicating the overall downforce in Newton. The horizontal scale is representing the time in seconds relative to impact. Impact is exactly at a time = 0 seconds. The data under the graphs show the time and the down force at the actual cursor position.

The downforce at *Setup* (green line) for this player is about 1050N. The downforce maximum in the downswing is 1550N and the downforce at *Impact* (red line) is about 1035N. The corresponding FORCE FACTOR describing the ratio of the downforce at impact relative to the downforce at *Setup* will then be about 0.98. The downforce minimum after impact is 574 N only. Also in the follow through the downforce will be reduced as the body continues to move up into the end position.

## 2. COP lateral

The **COP lateral** data curve represents the time course of the center of pressure (COP) data in the lateral (left / right) direction. The COP lateral curve data is calculated in percent of weight distribution and not as a position on the force plate. Therefore, the COP lateral data corresponds exactly to the data which is shown on the bull's eye graph at the right.

To load and unload your body and to transfer this energy to the club, a lateral weight shift is necessary. If the weight shift is too small then the corresponding golf swing lacks of power and is controlled by the upper body. A big lateral weight shift range means, that you are actively using your lower body to build up power and to accelerate the club properly.



The data is shown on a vertical scale from -50% (all weight on the right foot) to +50% (all weight on the left foot). In example, a COP position of -27% from the center to the right corresponds to a weight of 77% at the right foot (50% + 27%) and 23% of weight at the left foot.

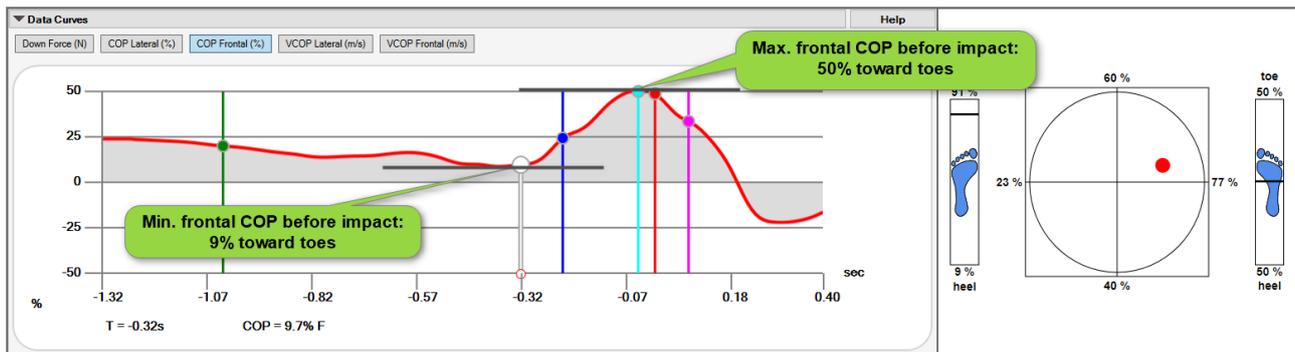
The horizontal scale is representing the time in seconds relative to impact. Impact is exactly at a time = 0 seconds. The data under the graphs show the time and the lateral COP data at the actual cursor position.

This player reaches his maximum weight shift right (MSR=-27%) about 200 ms before the top of backswing TOB (blue line). The maximum shift left (MSL=33%) is reached shortly after TOB. The total lateral **COP Range** parameter for this player is then 27%+33% = 60%

### 3. COP frontal

The **COP frontal** data curve represents the time course of the center of pressure (COP) data in the frontal (heel / toe) direction. The COP frontal curve data is calculated in percent of weight distribution and not as a position on the force plate. Therefore, the COP frontal data corresponds exactly to the data which is shown on the bull's eye graph at the right.

For a stable and consistent swing it is necessary to minimize the weight shift and imbalance between heels and toes. Inappropriate weight shift into front/back direction often ends up in off center hits and an improper club path.



The data is shown on a vertical scale from -50% (all weight on the heels) to +50% (all weight on the toes). In example, a COP position of 10% from the center to the front corresponds to a weight of 60% at the toes (50% + 10%) and 40% of weight at the heels.

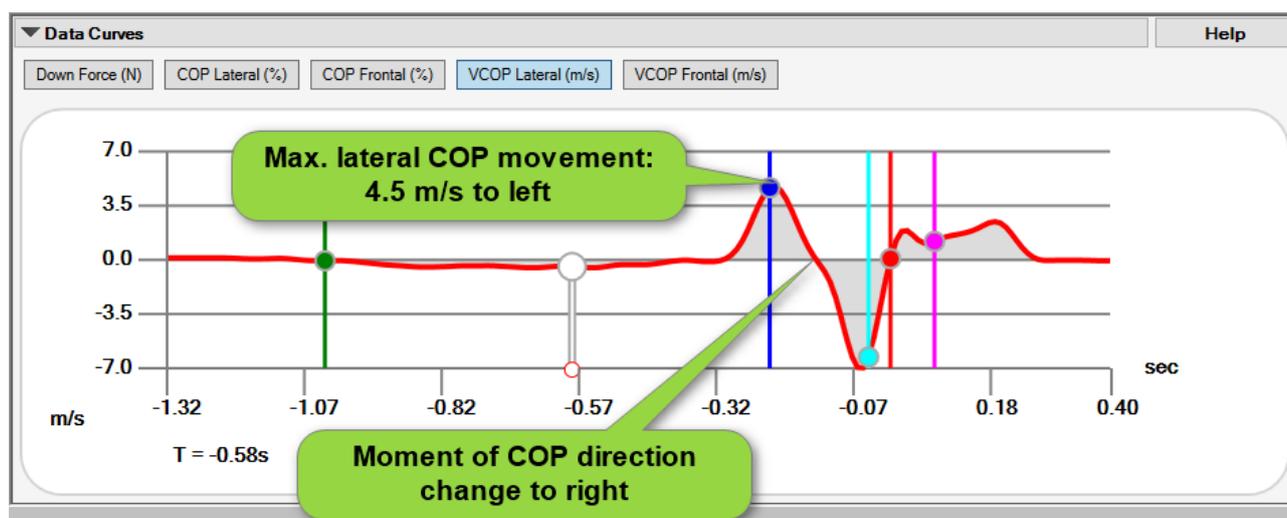
The horizontal scale is representing the time in seconds relative to impact. Impact is exactly at a time = 0 seconds. The data under the graphs show the time and the frontal COP data at the actual cursor position.

In this example the frontal COP curve stays above the zero line between *Start* (green line) and *Impact* (red line), indicating that the weight is always more at the toes. The minimum COP value is 9% towards the toes and the maximum COP value is 50% towards the toes (which means all weight is on the toes in this moment). The **COP STABILITY** parameter for this player is then  $50\% - 9\% = 41\%$ .

## 4. VCOP lateral

The **VCOP lateral** data curve represents the time course of the speed of the COP movement in the lateral (right / left) direction. The COP speed corresponds to the change of the COP position on the force plate per time and not directly to the lateral COP position in percent.

The VCOP speed curve allows to inspect the dynamic aspects of the COP movement, which is moment of activation of the COP shift, and the extent of COP movement, both critical for the activation of the kinematic chain and for creating maximum power in a swing. The higher the COP speed, the faster the COP is moving. A high lateral COP speed peak early at begin of downswing corresponds to a distinct activation of the lower body and helps players to increase their clubhead speed and thus their total distance.



The data is shown on a vertical scale in m/s relative to the change of the COP position on the pressure plate. A positive speed corresponds to a movement to the left, a negative speed corresponds to a movement to the right. In example, a VCOP speed of 1 m/s corresponds to a change of COP position of 10cm in 100 ms to the left.

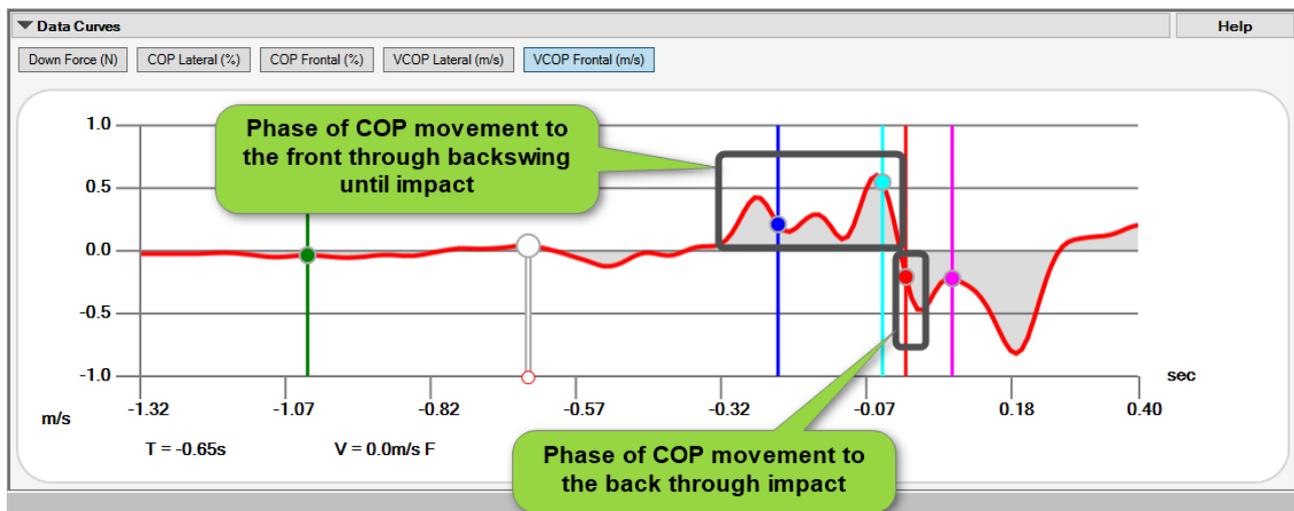
The horizontal scale is representing the time in seconds relative to impact. Impact is exactly at a time = 0 seconds. The data under the graphs show the time and the lateral VCOP speed at the actual cursor position.

The COP speed of zero during *Setup* (green line) indicates that the COP is not yet moving. Also in the backswing this player is moving very smoothly, the lateral COP speed is only about -0.5 m/s to the right. Already before reaching *TOB* the lateral COP speed changes direction, but then directly after *TOB* (blue line) this player reaches an extremely high maximum lateral COP speed (4.5 m/s to the left). After this peak the velocity steeply drops and is already at a negative peak at *Delivery* (light blue), indicating that the COP is moving back to the right. Already before *Delivery* the COP movement has stopped allowing the upper body to start to accelerate. The lateral COP speed is neutral again through *Impact* (red line).

## 5. VCOP frontal

The **VCOP frontal** data curve represents the time course of the speed of the COP movement in the frontal (heel / toe) direction. The COP speed corresponds to the change of the COP position on the force plate per time and not directly to the lateral COP position in percent.

The VCOP speed curve allows to inspect the dynamic aspects of the COP movement, which is moment of activation of the COP shift, and the extent of COP movement. In contrast to the lateral COP movement, the frontal COP movement should be quite limited, as high data values for frontal COP speed indicate imbalance. For a stable and consistent swing it is necessary to minimize the weight shift and imbalance between heels and toes. Inappropriate weight shift into front/back direction often ends up in off center hits and an improper club path.



The data is shown on a vertical scale in m/s relative to the change of the COP position on the pressure plate. A positive speed corresponds to a movement in direction of the toes, a negative speed corresponds to a movement to the heels. In example, a VCOP speed of 0.5 m/s corresponds to a change of COP position of 5cm in 100 ms to the toes.

The horizontal scale is representing the time in seconds relative to impact. Impact is exactly at a time = 0 seconds. The data under the graphs show the time and the frontal VCOP speed at the actual cursor position.

The COP speed of zero during *Setup* (green line) indicates that the COP is not yet moving. During the backswing this player is moving the COP slightly into the heels, the frontal COP speed is slightly negative. Just before reaching *TOB* the frontal COP speed is becoming positive, indicating a significant COP movement to the toes. Also during downswing this player continues to shift the COP to the front until *Delivery*. After *Impact* (red line) the frontal COP is moving back into the direction of the (heels).