DOES THE CLUB RETURN TO THE INITIAL SHAFT PLANE: HOW TO PROVE OR DISPROVE IT?

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Abbreviation

BA – breakaway
BI – ball impact
DTL – down the line
FSP – functional swing plane

Introduction

One on-going controversy in the golf community is whether at impact the club returns to the initial alignment plane or not. Some swing models are based on this premise that the club actually returns to the initial shaft plane. It is a simple matter in the eyes of mechanics (i.e. Newton's Laws) to prove or disprove this notion but the controversy somehow continues, which is perhaps because of the methods used in proving the notion.

Video clips of legendary players taken in the DTL view (with shaft lines added) have often been used to prove the notion. DTL-view video clips, however, have several issues. Most video clips were taken at 25-30 Hz frame rates so it is hard to detect the exact instant of impact. The shutter speeds used were low so the image is fuzzy. But, more importantly, the perceived shaft alignment is substantially affected by the camera position (both horizontal and vertical) and distance from the golfer since the main club motion occurs in the direction of observation (down the line).

The notion can be proved or disproved in a straight-forward manner if 3-D swing data of the players are available. For example, Figure 1 shows the club alignments at setup (BA) and impact (BI) of two PGA Tour-caliber players (driver). The stick figure image was aligned along the FSP so the difference (or similarity) in the club alignment at the two events is clearly demonstrated. Player A shows the typical alignment pattern in which the club forms a substantially steeper plane at impact than at setup. Player B exhibits an unusual pattern in which the club returns close to the initial alignment plane. This designation of 'typical' or 'unusual' is based on 200+ elite players that we've analyzed so far. For male elite golfers, the hands at setup are deviated from the FSP by 12-14 cm on the average.

Since not everyone has the capability to collect 3-D swing data using motion capture technology, there must be another way to prove or disprove the notion in a relative error-free manner. The purpose of this note is to present a simple video-based method which can be use in proving or disproving the notion that at impact the club returns back to the initial alignment plane.

Video-Based Method

The DTL view is sensitive to the perspective used, i.e. the camera position (horizontal and vertical) and distance from the golfer. A more reliable way to assess whether the club returns back to the initial alignment plane is to use the frontal view instead. Figure 2 shows various club alignments in two different perspectives: initial shaft alignment plane view and frontal view. The vertical position of the hand center changes depending on the shaft angle formed against the vertical line.

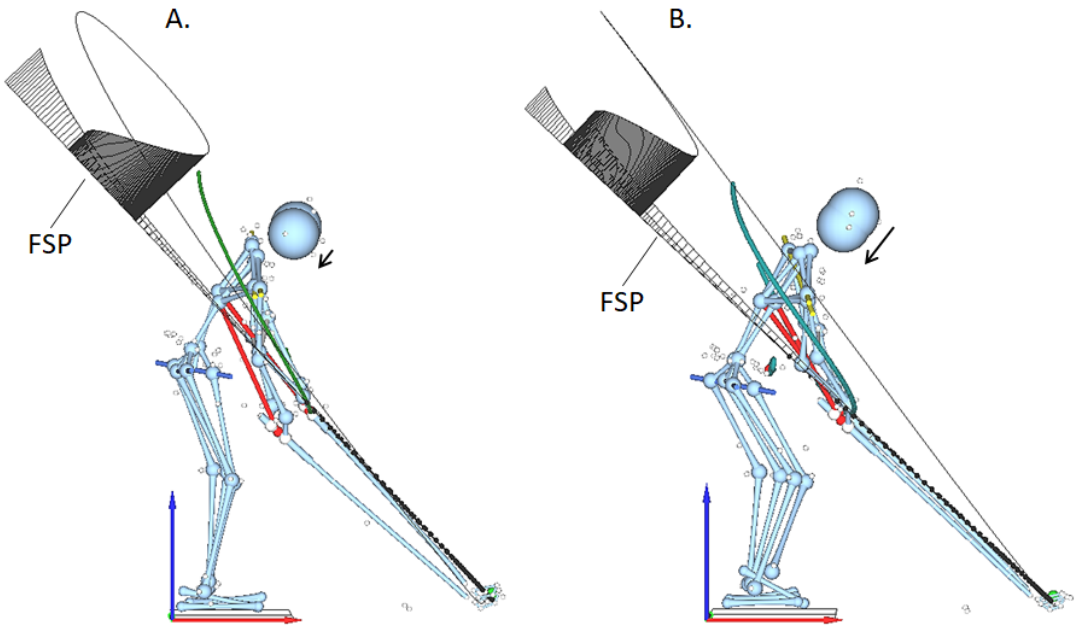

Figure 1. Shaft alignments at setup and impact of two PGA Tour-caliber platers (driver). The view is aligned along the functional swing plane (FSP), the plane of motion of the club.

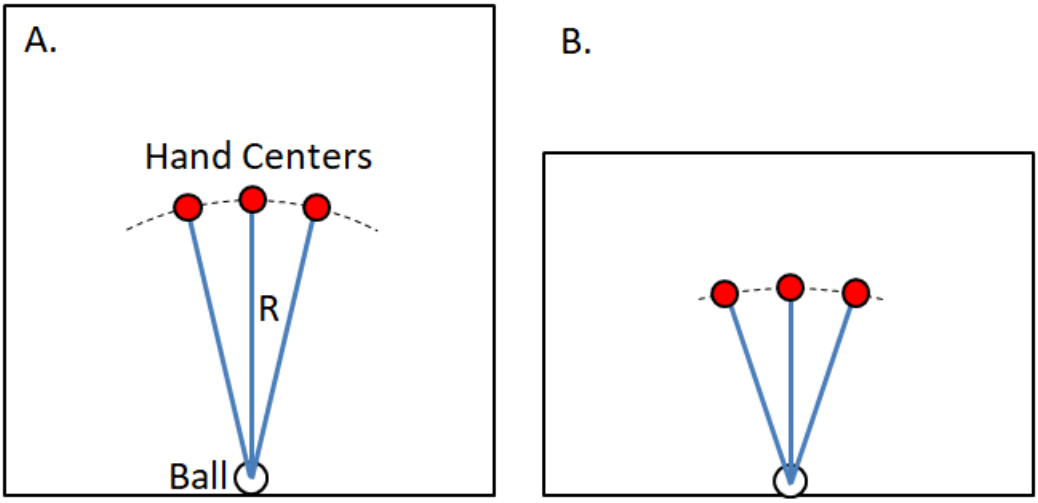

Figure 2. Club alignments at two different events: initial shaft alignment plane view (A) and frontal (face-on) view (B).

In Figure 2A the camera is placed perpendicular to the initial shaft alignment plane. If we assume here that the club actually returns back to the initial alignment plane, the hand center should be on the initial shaft alignment plane at setup and impact. In other words, the hand centers at both events should be on a circle centered at the ball with radius R (distance from clubhead to hand center). When the club alignment is assessed in the frontal view (Figure 2B), the image must shrink vertically to certain extent and the hand centers must be placed on an ellipse centered at the ball. So the club appears longer as the angle from the vertical line increases.

The perceived club alignment is less sensitive to the perspective in the frontal view as the main direction of motion of the club is almost perpendicular to the camera axis. Figure 3 shows the club alignments at setup and impact of the same two players in the frontal view. Player A is characterized by a more vertical club alignment at impact than at setup (Figure 3A). In this case, if the club returns back to the initial alignment plane, the club at impact (red line) should appear shorter than that at setup. Player B on the other hand is characterized by almost vertical alignment at both events (Figure 3B) and the club lines are quite similar in length.

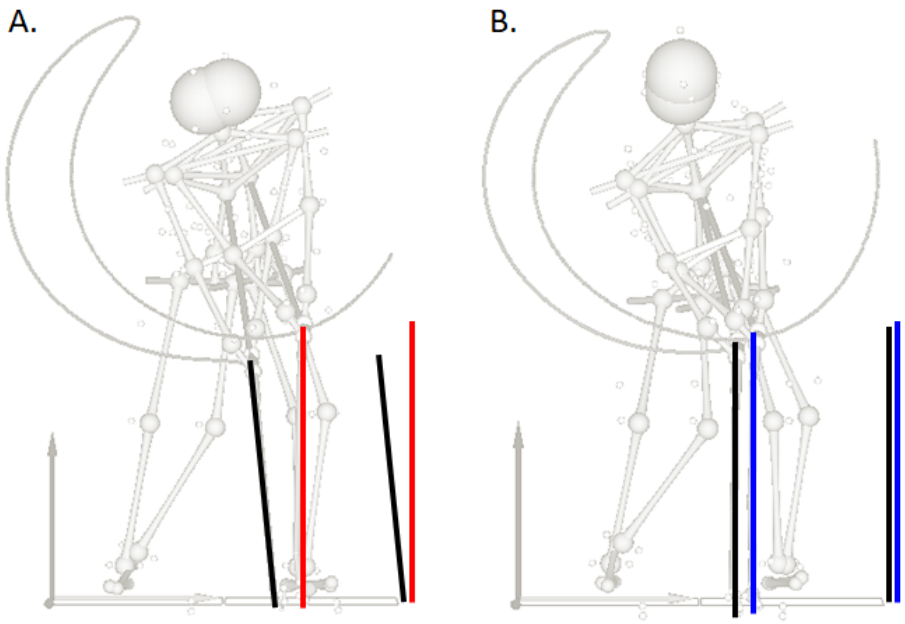

Figure 3. Lengths of the club at setup and impact assessed in the frontal view of two PGA Tour-caliber players

Therefore, the club lengths observed in the frontal view can be used in proving or disproving the notion that the club returns back to the initial alignment plane. For a wood or iron shot of grounded ball, the vertical positions of the hands at setup and impact can also be good indicators as well.

Application

A quick search on the Internet proved that it was not that difficult to find some good quality high-speed video clips of currently active golfers. Figure 4 shows the setup and near impact images of two popular players, Justin Thomas (120 fps) and Jason Day (16,000 fps). Here, it is not necessarily to use the still image of the exact impact instant as the club stays on the same plane of motion near the impact and it should be acceptable as long as the instant is close enough to impact. Both cases, the club length observed in the frontal view at impact was substantially longer than that at setup. This disproves the notion that the club returns back to the initial shaft alignment plane in modern golf at least.

In fact, this trend of separation between the motion plane of the club near the impact and the initial shaft alignment plane gets more obvious as the swing speed gets faster. With a fast moving club held it is mechanically challenging to move the hands far down in order to bring the club back to the initial alignment plane. In mechanical perspective, the pattern shown by Player A in Figure 1 is normal.

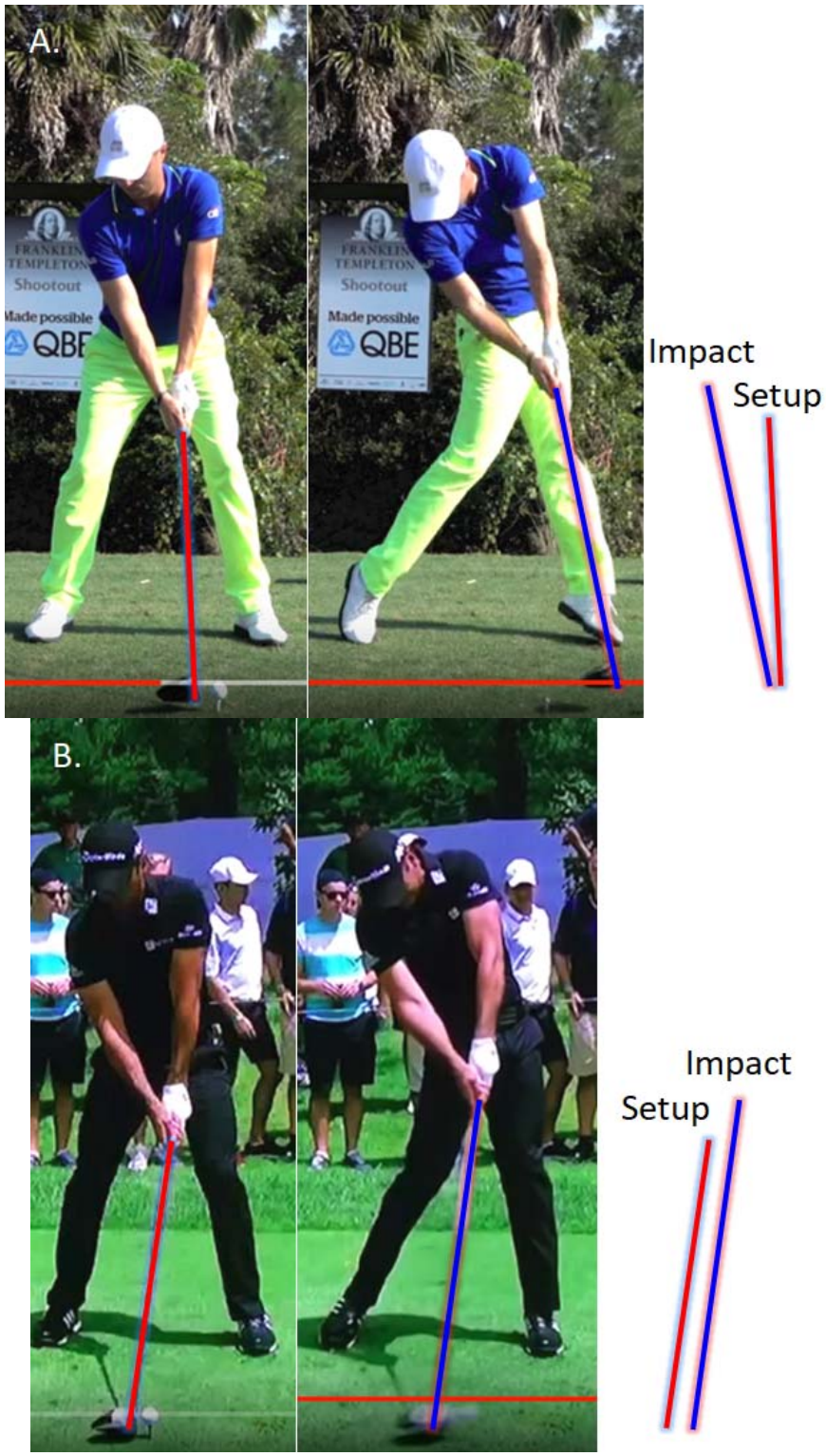

Figure 4. Slow motion video clips of Justin Thomas (A) and Jason Day (B) (Adapted from GolfswingHD and RollYourRock's Youtube video clips)

Golfer's swing style also affects the degree of separation in shaft alignment between the two events. For example, Player B in Figures 1 and 3 is characterized by a relatively steeper initial club alignment at setup. Due to excessive knee flexion throughout the entire swing, his swing plane is also flatter than normal (about 43°; driver swing) and his head moves down substantially more than Player A.

The separation in shaft alignment angle between the setup and impact events may get less obvious, however, as the club gets shorter. This is because the slope of the initial shaft alignment plane increases as the club gets shorter so there is less room for increase in the shaft alignment angle at impact.

Summary

A simple method based on frontal view swing images was presented in this technical note. Club alignments observed in the DTL view images are sensitive to the perspective and camera location and prone to error such as parallax error. Apply this method to frontal plane high speed video to see if your player brings the club back to the initial alignment plane or not. More importantly, in mechanical perspective, trying to bring the club back to the initial alignment plane in the downswing actually hinders a natural progression and speeding up of the club motion.

(Last modified in April 2018)