

THE ROLE OF TECHNOLOGICAL ASSESSMENT WITH BIO-FEEDBACK FOR THE GOLFER.

Strategies and objective assessment to improve performance.

KEYWORDS

- Golf
- Athletic preparation
- Digital training
- Bio-feedback
- Functional technological assessment

ABSTRACT

In the panorama of sports and categories of athletes for which it is possible to carry out functional tests and training protocols with **technological bio-feedback**, **golf** represents a discipline rich in ideas and in some ways little explored.

Technological evaluation constitutes an important means of processing data useful for the athletic trainer to work on **perfecting the gesture** of his/her golfer.

In a discipline in which details and maximum concentration play a fundamental role for performance, it is essential to use the **objective evaluation approach** to explore every physical limit in a given district that is important for **swing**, the technical gesture par excellence in golf. Each point of weakness, in fact, translates into a specific technical defect and requires a path to build performance.

In this contribution we analyze how TecnoBody's approach with evaluation technology supports golf technicians and the specific courses the coach can take to **treat the performance** of the modern golfer.



Figure 1: The Follow-through gesture on the Golf course

The importance of the correct swing

The **swing** is the technical gesture par excellence in golf, the basic movement for each shot during the sessions of this discipline.

Many studies have shown in recent years that the swing gesture is **among the most complex**, second only to that of the pole vault.

To achieve a **perfect swing**, the golfer must focus on **4 different phases**:

- The positioning (**Backswing**),
- the drop (**Downswing**),
- the impact (**Moment of truth**),
- the end (**Follow-through**)

The movement of arms, shoulders and wrists, together with the mobility and control of the trunk, determine the best gesture and therefore the **highest performance**.

It goes without saying that the perfect swing does not exist, as it is mandatory to take into account the **physical characteristics of a player**, his **motor skills** and the events in the external environment at the time of the ascent and descent of the club.

But the swing can be trained in the right way. Preparation and analysis of the gesture determine a **refinement of the technique** and today it is essential for the technician to prepare the golfer by sensitizing him on the objectification of his **strengths and weaknesses**.

The muscular effort in the swing gesture

The swing turns out to be a perfect exercise to activate the **muscles of the spine** thanks to its three-dimensional characteristics:

- **extension**, in the sagittal plane;
- **rotation**, on the transverse plane;
- **lateral flexion**, on the frontal plane.

In fact, the swing fully respects the physiology of the human body and of the spine in particular, even though it is a very fine movement that requires **maximum functional efficiency** in the three planes of space.

Often the gesture is perceived as difficult by beginners, both because it derives from the **combination of different body districts**, and because it requires an unnatural movement in everyday life, that is, it stimulates muscles that are usually rather inactive and finally because it requires **considerable coordination**.

Furthermore, the coordination and timing factor of the movement combined with the control of balance are very important factors for the success of the gesture.

In summary, in the execution of a good swing the following come into play:

- **solidity of the lower part of the body;**
- **good mobility and torsion capacity of the trunk as opposed to the pelvic area;**
- **control and elasticity of the upper districts.**

After these premises, it is clear how the importance of the correct execution of a swing has an impact on two fundamental aspects of performance:

- injuries prevention;
- the highest performance.

The analysis of the technical gesture with D-WALL

The analysis of the technical gesture through functional evaluation with **technological bio-feedback** on the **D-WALL** digital mirror can highlight abnormal movements that can cause the crisis of a body district.

Thanks to the combination of **infrared 3D camera** and the **stabilometric platform**, it is possible to have information on the **joint ROM** of all the main joints, COP and ground forces expressed by the subject.

The **Motion Analysis module** of D-WALL is an evaluative section that allows you to analyze the joint kinematic ranges during any dynamic movement and all the displacements of the **Center of Pressure (COP)**.

The software also guarantees the possibility of being able to create time windows of interest, called **Bookmarks**, in which to enclose the analysis and calculate the results during the various phases of the Swing analyzed, to be able to save and print a report and finally to be able to review in a second moment every single frame of the test.

This last aspect is of fundamental importance for what concerns the analysis of the movement, as it allows to **extrapolate the frame** of the video of interest to analyze it from a visual (image) and numerical (joint/kinematic data) point of view afterwards.

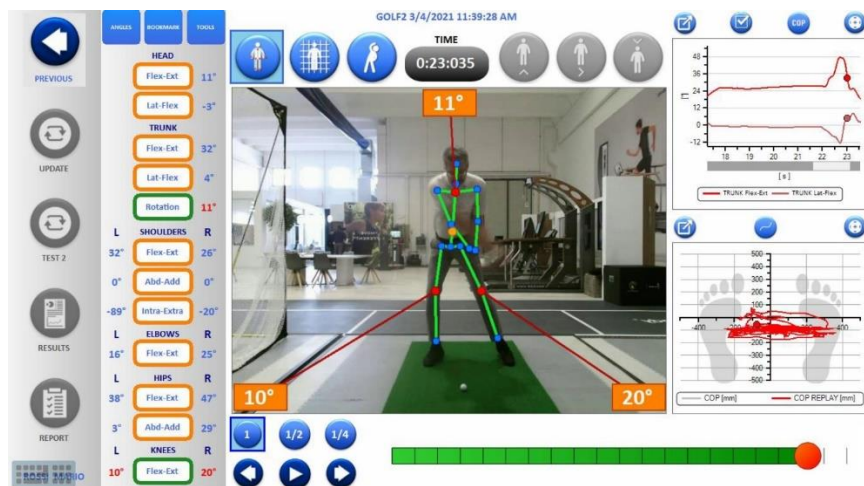


Figure 2: Motion Analysis of the technical swing gesture through the analysis of joint degrees on D-WALL

The Backswing analysis

Probably the most crucial phase of a swing is the **change of direction**, that is, from the moment in which the golf-club and the body return to the target.

The backswing and the subsequent downswing must absolutely be joined by a **single fluid and dynamic movement**; so often it happens to see golfers who make a soft backswing but then make a more than modest shot because they bring the golf-club back to the ball, while the transition between a backswing and a downswing must be done in a loose and never hasty way.

For a split second the body will move simultaneously in **two directions**: as the trunk completes its twist, the lower body already begins to move in the direction of the target.



Figure 3: Backswing

Precisely for this dynamics of movement and for the involvement of the trunk, **the analysis of the COP is essential** to verify the quality of the gesture.

The parameters that can be selected for the analysis are:

- the **joint angular values** (minimum, maximum and average angle),
- the **COP** (average X, average Y, area and perimeter),
- the **force expressed** on the platform.

Based on the objectives of the free test established by the operator, he himself will evaluate the parameters to be taken into consideration, to make an objective and objective analysis of the movement.

COP [mm]

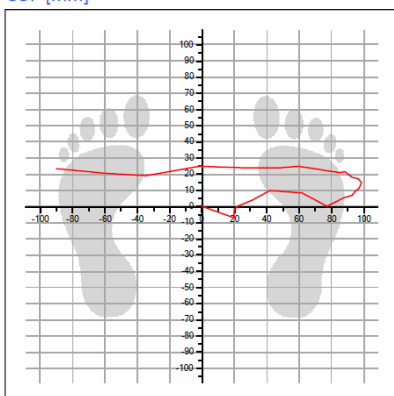


Figure 4: Displacement of the COP during the back swing phase

In the report containing the graphs, for each bookmark the series relating to the selected parameters will be **visible in pairs of two** in the order of selection (therefore a maximum of three graphs each containing two series) and the COP graph if selected.

The **management of the COP** during the backswing phase will be an important analysis parameter to determine if the center of pressure recorded on the ground moves with a fluid movement; this should progressively move towards the other affected, or the one with the greatest load.

Down-swing



Figure 5: Down-swing

The **smooth transition** from backswing to downswing depends on the action produced by the **lower part of the body** and specifically by the **legs**, which represent the stabilizers of the swing, as they provide the necessary balance and support the trunk during its twisting.

While the trunk is about to complete the backward movement, the forward passage is favored by the slight diagonal movement of the left knee in the direction of the tip of the left foot.

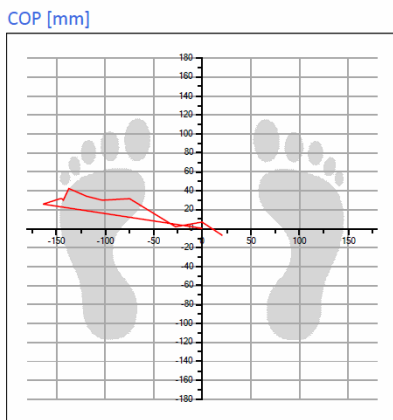


Figure 6: Displacement of the COP during the down-swing phase

The **proprioceptive aspect** of the feet is of fundamental importance so that a correct transfer of the COP occurs and consequently the concept of stability on the ground and transfer of force upwards is not lacking.

The more the movement between backswing and downswing remains **fluid** and with a progression of transferable force from the ground (feet) to the top (pelvis, trunk and upper limbs), the greater the performance at the exit, especially from a technical point of view.

The impact analysis (moment of truth)



Figure 7: Impact, or moment of truth

The moment of impact cannot fail to respect the fundamental criteria.

A sore knot for most players, the impact is sought with every strength without really understanding and feeling that it is not a point of arrival, but a simple and **important crossing point**.

Precisely this search to hit and not to cross, excessively increases the **pressure of the hands** and the rigidity of the arms, preventing the build up of the fluidity and control necessary to keep in order a movement that ends much later.

Described in part already in the downswing, on impact you have the hips already in the direction of the target, the shoulders less rotated, the cap of the golf-club pointing to the left pocket, the hands are forward to the left with respect to the head of the iron, left arm and shafts form a single line and the right heel is already raised.

Newbies think that this is a really unnatural gesture, but unfortunately the only reason why we feel that strange sensation of making an unusual gesture, lies in the fact that **only the hands are connected to the golf club**, the point therefore most used in our everyday life. Understanding that the hands are a means without an engine, dragged up to the impact by the body, is difficult for us to perceive from the beginning.

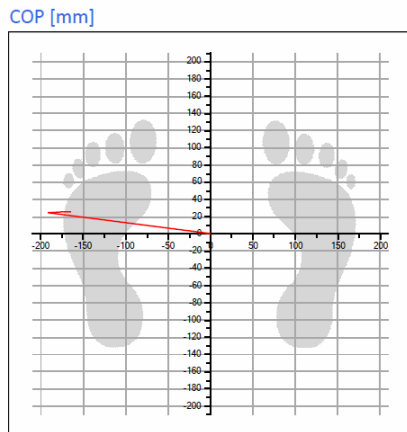


Figure 8: Displacement of the COP during the impact phase

Remember, as for any sport or motor movement, it is never the single muscle that acts, but the **set of joints**, moved by the muscles to achieve a specific motor task.

For this reason, especially in golf, we are talking about **kinetic muscle chains**, that is a sequence of movements that start from contact with our feet on the ground (**segmental and global proprioception**), and that up to the last phase, involve a kinetic/muscular transfer, through the crossed chain up to the end of the hand and then its extension with the golf club.

Many times this aspect is underestimated and starting with a **poor proprioception of the foot** on the ground can affect the success of the motor task. It is good to dedicate time to train this component, sensitizing the subject to the transfer of the load and the physiological displacement of the COP during the different phases of the required movement.

Follow-Through



Figure 9: Follow-through

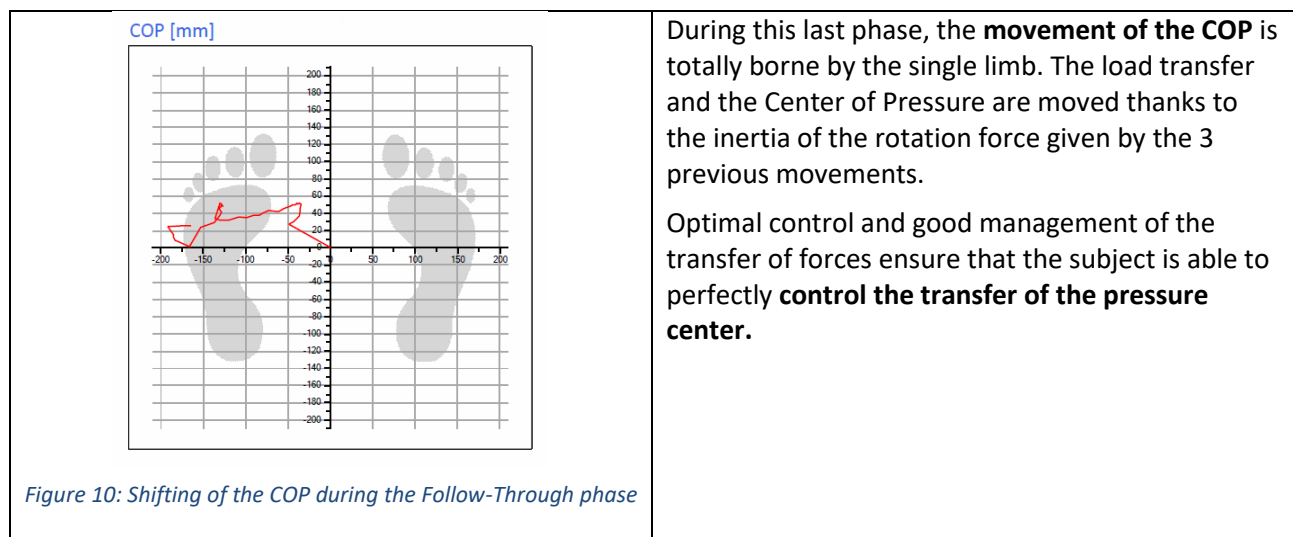
The **end of a golf shot**, as with other athletic gestures for which a tool is used, is largely a mirror of what has been done before, of where one has passed and of how one has arrived there.

The impact leaves us with very **useful feedback** to understand how much good or wrong there is in the athlete's stroke.

Surely this statement is much more relevant to a novice or medium-level player, where by carefully observing even a recording of the gesture on the monitor or analyzing the **precarious balance** that you have in the final position, you definitely understand what the points are on which to intervene to correct the movement.

On average in a good player there are control points that make us assume that the shot did not go so badly and that the swing was performed with **stability, control and well organized**:

- the **right foot** completely rotated which, using the external sole of a common golf shoe, reaches the tip of the foot;
- the **hips** in the direction of the target;
- **shoulders** rotate more to the left side of the line you are playing on;
- **the left shoulder, hips and knee line**;
- the **balance** that cannot be missed and must be sought in every stroke even if the athlete feels he has not had an optimal impact, a stable and comfortable position.



The golf preparation with the D-WALL digital mirror

As it may be easy to guess, a golfer's training must take into consideration many variables, such as mobility, balance ability and motor control of the subject.

It is possible to perform different **exercises** with bio-feedback control of both the **displacement of the center of pressure** and the **movements of the trunk**.

Within the D-WALL training libraries there are different athletic training programs dedicated to the golfer that provides sport-specific exercises of both functional and preventive character.

There are different trainings, different by objective, which constitute a good basis for **training the core**, the **lower and upper limbs**, in monopodal and bipodalic position both through the use of **destabilizing tools** such as elastic bands, airex and proprioceptive golf.

The D-WALL **Golf Preparation Module** includes numerous exercises which include:

- COP Training;
- load management (monopodalic, squat, lunges);
- mobility and control with destabilizing elements;
- mobility and control of the upper limb and spine.

By way of example only, we analyze below the execution of three fundamental exercises for core stabilization and control with a focus on rotation.

1. Balance management

The 4 phases seen previously are now managed thanks to the use of a **proprioceptive tablet** placed under the feet. The tablet exhibits instability only at the mid-lateral level; this allows the athlete to stabilize the anterior-posterior displacement while managing the tone and lateral displacement.

As previously mentioned, the 4 phases are characterized by **soft displacements of the center of pressure (COP)**, the use of the proprioceptive tablet serves to **improve the level of inter and intra muscular coordination**, further **sensitizing the foot segment and the mobility of the ankle**.

Furthermore, working on an unstable surface introduces a considerable degree of difficulty in managing balance, preparing the subject and thus being preparatory for all those conditions in which the athlete may find himself hitting the ball in "uncomfortable" situations given by the natural depressions of the ground.



Figures 11,12,13,14: D-WALL Training with bipodalic load on wireless proprioceptive tablet

2. The core control

Through the use of a **fitball** and a **fluiball**, the athlete is asked to control the **abdominal core** with feedback regarding the rotation of the trunk.

The main focus is the **stabilization of the torsional movement** given by the rotation speed and the instability of the fluiball.

The athlete, therefore, performs controlled lateral rotation movements on both sides while the technician checks the execution of the movement and the corresponding degrees of rotation on the monitor, **avoiding hyper-rotation**.



Figure 15: Core training with destabilization accessories on D-WALL

3. Stabilization

Through the static forward lunge exercise, the required movement involves a rotation of the trunk, taking the **fitness barbell** as a reference.

The technician educates the user to involve mainly the torsion of the torso and segment the trunk-pelvis complex.

Through the use of joint bio-feedback, both the user and the trainer check the quality of movement with regard to the **trunk segment** and the **flexion of the knees** in the sagittal plane.

The technician can then customize the flexion-extension values of the trunk adapting them to the movement to be followed and to the posture of the subject.



Figure 16: Stabilization training on D-WALL

Conclusions

Through the evolution of the process of applying technology to analysis and training, it is possible to analytically observe **complex sport-specific movements**, such as golf, in order to optimize the required performance.

The objectification of the **numerical data** allows the technician to set up the re-education and/or optimization work customized for each subject.

Real-time feedback makes the athlete aware during exercise and sensitizes him to the high degree of concentration required during a golf competition.

It is desirable that technicians and trainers in this area are increasingly oriented towards the objectification of the data to monitor the athlete's path, accompanying him towards the **highest performance** and towards the most coveted hole on the golf course.