

Balance & Stability

the key to power & consistency in batting...

Biomechanical analysis is the ‘why’ something happens. It is down to the skill of the coach and the relationship with the player to decipher correctly the ‘cause and effect’ of any movement observed... The question I posed in my last article ‘Batting is a side-on game – or at least it used to be’ was this... “If you increase your stability during the position of readiness, what effect would this have on perception, accuracy and consistency?”

To recap the ‘Position of Readiness’ (POR), or dynamic balance, is as a result of Newtons’ third law (law of reciprocal actions). For every action there is an equal and opposite reaction. The stance is the "ready" position when the batsman is about to face a delivery. It is the base to play all your shots and as the majority of coaching material states, “you need to be comfortable and relaxed at stance”. If the fundamentals of a good set up are not present, the required chaining effects of movement cannot occur efficiently and effectively. I have had the opportunity to discuss this topic with a number of ECB coaches over the last few months, with some interesting concepts and coaching philosophies expressed.

To strike a cricket ball, a balanced and stable base must be first created. Balance means equilibrium, or when forces acting on the body are equal. The notion of a pre delivery trigger movement before ball release is an opportunity for the batsmen to move into a more dynamic and balanced position. This increase in momentum can be later utilised during the stroke. You are more likely to get into a balanced position if you start in a balanced position. However, the movement must enable the batsmen to arrive at a balanced position at POR in order to benefit from the trigger movements. Too many players are in a poor position at POR as a result of poor timing with their trigger movements, or inconsistent trigger movements as players do differ during the stages of an innings, different movements to different bowlers... there is a lot of room for inconsistency. Have a pre-delivery movement by all means, but ensure it is consistent and timing is spot on!

A stable base or a position of dynamic balance at POR ensures:

- Increased resistance to work the body levers against other body parts – summation of force – heavy parts move first, transferring momentum to the lighter, faster moving body parts...
- Body energy transferred efficiently to the bat
- Full force generation

One of the most naturally gifted golfers I ever coached owed his considerable ability to a childhood spent playing table tennis in which he later represented his country. You may ask what the link here is to cricket, but because we are encountering him in a biomechanical context, his body awareness and most importantly dynamic balance enabled him to progress very quickly... it was all down to balance at address.

If an athlete achieves equilibrium he or she has an inordinate advantage over every competitor that does not. The likelihood is that the majority of children do not have it. But they can learn, and quickly too. Static balance is key in a number of sports, from football goalkeepers, archery, golf, darts or even the

cricketer in the slips. Dynamic balance however comes very much into play during the batting, keeping, throwing and bowling action. For instance, where the bowler needs to have all forces in the same plane and moving in the same direction during the delivery stride.

David Beckham's missed penalty in the World Cup 06 was due purely to lack of balance and stability of the non-kicking foot. To kick accurately and powerfully, you have to have a stable left ankle, foot, knee, hip and pelvis as the right foot impacts the ball. Beckham's foot clearly slipped as he made ball contact and the ball missed by some distance... immediately afterwards, you could see him looking down at the ground to see what had gone awry. Somehow, I cannot imagine seeing Johnny Wilkinson make the same error. Part of his pre-kicking drill is to check where his left foot is planted when he kicks, and if there is uneven ground or another type of irregularity he addresses it first, because he understands how being off-balance and unstable would affect the outcome of the kick.

It is similar for the full golf swing. When you watch professional golfers on TV, they seem to hold their finish for what seems like an age, even until after the ball has landed in some instances. It's a conscious finish to ensure they are balanced (or to make sure the camera man gets a good picture!). If they couldn't hold the posture it would be due to lack of balance. They need to be aware of it to correct it for the next drive – or even the next stroke. The goal of a good drive in golf is to achieve maximum distance with an acceptable level of accuracy. In order to achieve this objective several parameters must be optimal; club head speed and quality of impact. Club head speed is the magnitude of the resultant linear velocity of the club head in conjunction with the quality of impact. This includes several factors relating to the position of the club head at impact, including but not limited to: club head path, point of impact of the ball on the club face, angle of club face at impact and effective striking mass of the club head. During the swing the golfer forms an open kinetic chain with the feet at the closed end, the club head at the open end and several body segments in between. Achieving the highest club head speed at impact is a consequence of the appropriate movements of all the segments in the chain. Several mechanisms can be used to achieve this goal, such as: applying greater muscular force through the limb segments, increasing in the distance over which the forces act, and by the number of, and sequence that the body segments are brought into action (Milburn, 1982). The sequencing of the body segments, from proximal (body) to distal (hands), can affect both the forces applied and the distance over which they act. Hence the timing and sequencing of the motion of the body segments during the swing is of paramount importance to an effective swing. This proximal to distal sequencing of motion can be displayed in several different ways: as linear speeds of segmental end points, as joint angular velocities, as segmental angular velocities and even as joint torques. When components of the body segmental angular velocities are used it is termed the kinematic sequence (AIM-3D Golf Manual, 2003).

Many top golf health and fitness professionals are now using motion analysis to analyze the golf swing. They use the analysis to design swing and exercise training programs with the resultant kinematic sequence a key parameter that underpins the program. Figure 1 shows the kinematic sequence of a world class PGA touring pro. The vertical black lines mark the events of address, top of backswing, impact and finish. The area of interest is the gray shaded area between the top of backswing (Top) and impact (Imp). The red line is the pelvis rotation speed; green is the thorax (upper body), blue is the lead upper arm and brown is the club. The images above the graph show the position of the golfer at four key points in the downswing, the peak rotation speeds of the pelvis, thorax, arm and club. During the downswing all body segments should accelerate and decelerate in the correct sequence with specific timing before impact. According to the theory of proximal to distal sequencing (Putnam, 1993), the

peaking sequence of the major segments for best energy transfer is: pelvis, thorax, arms and club. The motion should occur sequentially with each peak speed being higher and later (closer to impact) than the previous one. This pattern is necessary to efficiently transfer energy and accelerate each body segment. In addition to transferring energy across each joint, energy can be added by the muscles that cross each joint. In fact, if the timing is off and any of these actions occur too early or too late, energy can be lost and as a result final club speed may decrease. In addition to the order at which the segments work, it is very important that the equal and opposite effect occurs and reaching peak speeds, the muscles must decelerate; this is the key to creating maximum power. Think of cracking a whip or, flicking a towel, the crack occurs as a result of deceleration and stabilisation of the wrist. Recent biomechanical studies (AMM and TPI 2007) have shown that amateur golfers tend to have poorer coordination; weaker power production and inefficient energy transfer from segment to segment than professional golfers.

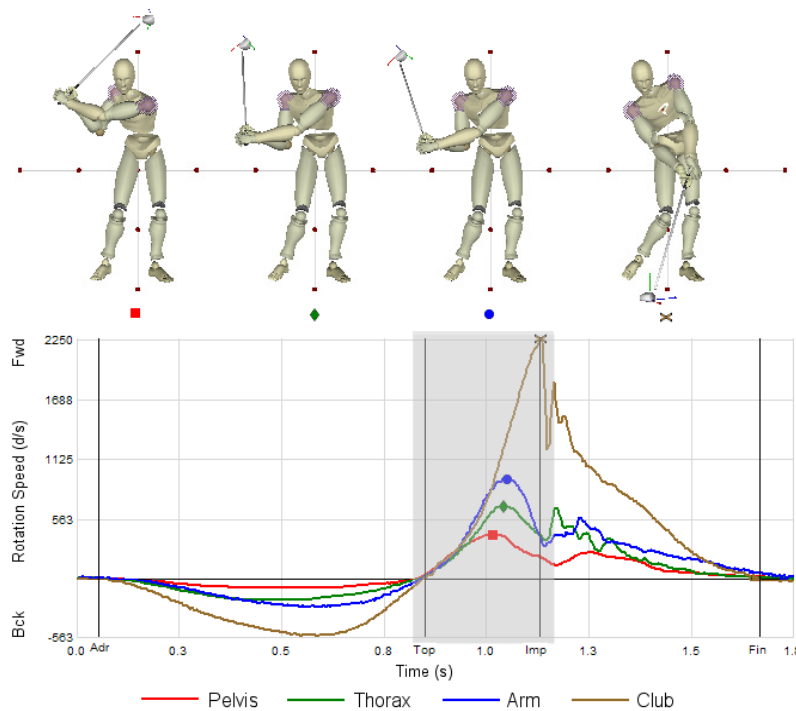


Figure 1. Kinematic Sequence
 (Image Courtesy of Titleist Performance Institute and Advance Motion Measurement)

Now translate this to the off drive in cricket batting. Video capture and 3D biomechanical analysis of body movements can analyse the sequence of events from backswing, transition, downswing to impact and follow through. As with the golf swing, during the downswing phase all body segments should accelerate and decelerate in the correct sequence with specific timing before impact. The peaking sequence of the major segments for best energy transfer is: pelvis (stable front ankle, knee and pelvis), thorax (chest / shoulders), both arms and wrists and finally the bat handle. The motion should occur sequentially with each peak speed being higher and later (closer to impact) than the previous one. This pattern is necessary to efficiently transfer energy and accelerate each body segment. As in the golf swing, if the timing is off and any of these actions occur too early or too late, then energy can be lost and as a result final bat speed and accuracy may decrease.

The momentum of an object can be conceptually thought of as the tendency of an object to continue to move in its direction of travel, unless acted on by a net external force. As such, it is a natural consequence of Newton's laws of motion. The amount of momentum that an object has depends on two physical quantities: the MASS and the VELOCITY of the moving object. The symbol for momentum is denoted by a small **p**

$\mathbf{p} = m\mathbf{v}$ where **p** is the momentum, *m* is the mass, and **v** the velocity.

The velocity of an object is given by its speed and its direction. Because momentum depends on velocity, it too has a MAGNITUDE and a DIRECTION.

Momentum is the product or combination of the speed and mass that the moving object or objects possess...

*To make the “same impact force the lighter cricket ball must travel faster”.
Lighter limbs must also travel faster to carry the same momentum as larger limbs.
Compared to the trunk which is HEAVY, slow but first to move!*

Heavy body parts are costly to move, slow, but do provide a good base to initiate power, therefore they must move first. Lighter body parts (cricket ball / bat) are easy to move, fast, adjust the final power output by the speed, therefore they must move last. Essentially, every time a large muscle group slows it supports the movements of the next smaller muscle group, which in turn seeks to maintain the same momentum value by increasing in speed. To apply power in the shot, the individual must set the base of support, so that he / she can step into position, stop (no further movement) then stabilise the specific joint, working from the ground up... ankle, knee, hip, pelvis, torso, shoulders, arms, then finally bat. This I refer to as the five S's

STEP / STABILISE / SHOULDERS / SWING / STRAIGHT

To summarise the rotational momentum the body segments are put on optimum stretch and move in a sequence, large to small, in a smooth well timed action to maximise the momentum over the greatest range of movement to generate the highest speed possible.



Olympic javelin silver medalist Steve Backley made huge progress by addressing his balance and stability when his back foot landed for the throw. A key focus was on how his forces worked in unison through correct alignment – the motion of his own centre of gravity. Through drills and conditioning, Steve superbly exemplified what we refer to encapsulate this crucial aspect of biomechanical performance – effortless power over powerless effort.

I give all my Tour golfers extensive balance testing more than anything else because it is really the beginning and end of good putting. If a golfer's balance is off his putting will suffer. Conversely, once he learns balance, so much else about the mechanics of putting just falls into place. Here is an outstanding exercise I use with elite golfers. Athletes from all sports can benefit hugely from this too. Stand on one leg for three minutes. It's hard. Your ankles know all about it very quickly. It's about stability, strength and muscular awareness. Specifically, though, this rapidly develops an awareness of balance through pro-perception, the ability to react to subtle changes in the position of the body's centre of gravity. Once you can do it for three minutes, close your eyes and try again!

The use of force and pressure platforms, 3D biomechanical software along with multi camera video analysis systems to show the equilibrium and balance transfer can improve athletic movement efficiency and accuracy. The key aspect is to make people more aware of their balance (or lack of it) during a physical movement. One tool I often use is to stand individuals on balance air cushions... the immediate action is to make movement feel awkward, but balance and stability follow on very quickly. It is interesting watching cricket batsmen trying to balance on the cushions in their so called 'position of readiness'. It simply highlights how inefficient their set-up position is and limited only to move in a certain plane, despite the batsmen not knowing where the ball is to be bowled.

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REFERENCES

- Advanced Motion Measurement, LLC. (2003). *AIM-3D Golf Manual*. www.amm3d.com. Phoenix, Arizona, USA.
- Milburn, P.D. (1982). Summation of segmental velocities in the golf swing. *Medicine and Science in Sports and Exercise*. Vol. 14, No. 1, 60-64.
- Putnam, C.A. (1993). Sequential motions of body segments in striking and throwing skills: Descriptions and explanations. *Journal of Biomechanics*, 26, 125-135.
- Titleist Performance Institute. (2007). *TPI-3D Golf Swing Biomechanics Software*. www.mytpi.com. Oceanside, California, USA.