Biomechanical Analysis Report (http://mitchbulmer.blogspot.com/)

1.0 Introduction

The racket sport of TT is fast paced and played with a lightweight ball. The sport demands high standards of hand-eye coordination, accuracy, balance, focus and concentration, quick reflex, and power. In addition to these skills, players require the ability to read the play, strategize and develop game play that allows them to effectively win each point.

TT features players with various techniques and methods of play; as can be seen in the sport many different types of skills are played. One such skill that can be analyzed is the FH top spin return. This shot is executed when the ball enters the player's side of the table and the player returns the ball to the opposition's side by applying force to the top of the ball using their FH shot. This creates a forward spin on the ball.

Through a Biomechanical Analysis a player can better understand the proper processes required and can break down each skill phases and work on achieving high standards of play. It is this analysis that will open up the world of TT in a logical, scientific light allowing the player to easily come to terms with the exact ways in which to achieve TT excellence.

The task requires a focus on the FH topspin return looking at each individual Biomechanical principle that is involved. The player shows many flaws which makes the analysis more valuable.

2.0 Methodology

The methodology outlines the task in relation to how data was acquired. It focuses on Primary Data and Secondary Data; Primary being main sources of information and Secondary being background or supplementary sources of information.

2.1 Primary Data

The task of analyzing Biomechanical principles required the filming of the player performing a FH top spin return. This was done by having the player set up with a continuous flow of balls hit into their court with the player then to execute the desired type of return. Two digital video recording cameras were placed at the front and side (Anterior view and Lateral View) to record all aspects of the shot. This allowed accurate data collection to occur as more than one angle was accessible for the player to then view and provide analysis on. Furthermore, a good shot and a bad shot were identified from the footage to be the focus of the player's analysis.

Dartfish, a video manipulation and analysis tool, was then used to import video data and find valuable information such as point of contact, angles of release and all other aspects that form the top spin FH return sub routine. In addition the useful tools available in Dartish, the program was used to capture still images to be included in the analysis report.

The task requires general overviews of Biomechanical principles to be included. To accurately do so, the Health and Physical Education text book, Amezdroz, Et El. 1999, was used as a primary source of data which provided reliable and abundant information for inclusion in the report.

2.2 Secondary Data

The purpose of secondary data is to present background knowledge on TT and Biomechanics and to provide supplementary information regarding the individual components that comprise these two studied areas.

This data was obtained from internet sources and included material such as definitions, diagrams and background data regarding Biomechanical principles. Additionally, this source of data allowed research of drills and methods of improvement within TT to take place.

3.0 Results

The results of the conducted recording of the player's FH topspin return can be viewed below. Still images have been captured from the recording showing the player's best example of the chosen shot and the worst example. These are identified as the player's good and bad shot, which will be shown in each table, with the good shot on the

left and the bad shot on the right. A brief summary of the two images will be presented in each table outlining the immediate flaws, ideal aspects or other features.

Table 1 – Angles of Body Position: Good v Bad (ANGLE)

These four captured images show a comparison between good and bad preparation. As can be seen in the player's Good shot (left images), the player demonstrates a body position that is closest to the 90 degree angles required at the knees and waist. Images on the left show more of a bent posture as opposed to the images on the right revealing a more upright posture. The benefits of a good starting position with be discussed in Section 4.0

Table 2 –Bat and Body Position: Good v Bad (Lateral)

The position of the bat and the body is imperative to a good FH topspin return. In the four images shown above, with Good on the left and Bad on the right, the player demonstrates similar body position in terms of whether or not the body is facing towards the opposition. In both instances, the player's torso is relatively front on to the opponent; however, the leg positioning is not ideal as they are, when looking at the feet specifically, angled to the side. This occurs in both shots so a comparison is difficult to be made. Despite this, discussion about the components of body preparation can still occur.

The next element of preparation looked at is the player's bat position and grip. In the Good shot, the player's bat is located further away from and lower than the ideal position. This removes the ability to decide whether to play a FH or BH (despite already knowing the shot would be a FH). The ideal position would be for the bat to be raised up higher and placed in front of the player with the handle pointing towards the player and the edge of the bat pointing forward; a ready position to play any shot. As can be seen in both shots, the player's bat is opened up, however, in the Good shot the bat is opened up more dramatically than in the Bad shot which leads to overshooting the table

The results of the four images provide inconsistent comparisons between a Good shot and a Bad shot as preferred aspects and unwanted aspects are present in both shots. This will be further discussed in Section 4.0

Table 3 – Path of Backswing: Good v Bad (Lateral)

As can be observed when looking at these four images, an interesting comparison between the Good shot and the Bad shot can be made. The results for the player's backswing are not as would be expected. In the case of the Good and the Bad shot, the player has actually demonstrated the desired backswing needed in the Bad shot and not in the Good shot; instead having no backswing whatsoever. Despite this, analysis of the Biomechanical principles involved in this technique can still be conducted.

Table 4 – Path of Forward Swing: Good v Bad (ANGLE)

The forward swing is essential to returning the ball. In the Good shot the player has dipped the bat before returning to the same height that they began the forward swing at. Also, this shows that the player has attempted to create topspin on the ball by coming up over the ball. This is contrasted to the Bad shot which shows the player moving up and making contact well above the starting height of the forward swing.

Table 5 – Height of Release: Good v Bad (Lateral)

These two images show a comparison between the heights of release. In both instances the bat makes contact above the table, however, in the Good shot this occurs at almost twice the height of the Bad shot. With this said, it is only an extra 12cm so the results are fairly similar. For more analysis on Height of Release, see Section 4.0

Table 6 - Angle of Release: Good v Bad (Anterior)

The angle of release in the Good shot is substantially better than the Bad shot (see bottom two images). This is due to the angle at which the bat is propelling the TT ball. In the Good shot the angle is 20.4 degrees, conversely, the angle is 32.7 degree in the Bad shot which means the face of the bat is opened up more which leads to the terrible show that follows, sending the ball flying away from the table and causing it to land m from the table top.

When looking at the angles and position of the arms (not angle of release), it can be seen that the player's arm is considerably straighter in the Good shot which allows the appropriate lever system to be fulfilled (see Levers in Section 4.0). In the Bad shot, the player's elbow is bent and raised higher than in a normal FH return. This, in turn, assists the unwanted generation of the shot that sends the ball in the opposite direction.

A definition and discussion on Angle of Release can be found in Section 4.0

Table 7 – Path of Ball: Good v Bad (Lateral)

The steps involved in generating a FH topspin return have been discussed in the previous tables. When looking at the two images above, it can be clearly observed which is the Good shot and which is the Bad shot. The image on the left (Good shot) shows a parabolic path of flight which causes it to land in the far cross-court section of the opposition's side of the table, as desired. This is evidently contrasted to the Bad shot which shows an unnatural path of flight, directing the ball to the ceiling.

This shot, too, is parabolic, but not nearly to the same standard as the Good shot, mainly as it does not travel in the right direction, and has a much higher maximum height. This will be further mentioned and discussed in Section 4.0

Table 8 – Path of Bat: Good v Bad (Lateral)

The path of the bat depicts the way in which the ball was hit. In both images the bat originates and concludes in closely the same place. Despite this similarity, the two shots are greatly different. When playing the Good shot, the player has performed a much better movement of the bat when compared to the Bad shot; a follow through which shows the bat being swung at heights higher than the actual player. This is concerning as the bat should never reach that height. Additionally the Bad shot shows the bat following a path that is considerably closer to the body of the player. These elements can be seen in greater depth in Section 4.0

4.0 Discussion

This section deals with the biomechanics involved in the sport of TT and focuses on their relation to the player's recorded performance. Additionally, the skill phases of the FH topspin return will be analyzed further.

The FH topspin return consists of many components that create a successful execution of each skill phase. The common characteristics of the FH topspin return, once an internal force (contraction of muscles in the body) is achieved, are:

1. The whip at the wrist, which gives the lever most of its speed
2. The rotation of the body parts which gives momentum and velocity to the striking arm
3. The large base of support, which gives good balance and allows forward movement of the trunk
4. The high position of the wrist which allows for the greatest force and the correct delivery position
5. The impact between the striking implement and the ball (also known as impulse)
6. The 'Parabolic' flight path of the ball
7. The reaction of the ball once it hits the table and the effect of topspin

(Mr Griggs' class notes)

These components will be looked at in closer detail through a deeper investigation of Biomechanical principles.

4.1 Biomechanical Principles

Biomechanical Principles is the body's mechanics, such as how muscles, bones, tendons and ligaments work to produce movement (http://www.thehoustonchiropractor.com/glossary.html).
It focuses on the mechanisms through which components interact to create movement. By providing insight into how body movements are carried out and the stresses that the movements place on the musculoskeletal system, both areas of study facilitate the design of safe and effective resistance training programs (http://www.gk22.com/resources/glossary.html). Furthermore, Biomechanics is the study of how living things move, and of the efficiency of movement, in particular. Knowledge of biomechanical principles can help us to understand how our bodies move and how we can make movement more efficient.

The Value of Biomechanical Analysis

The athlete and coach need a thorough knowledge of biomechanics and its application in general skill analysis so that sound techniques can be verified and errors in performance identified.

4.1.1 Force and Momentum

Newton's Law of Acceleration looks at **Force** which is defined as an action, whether it is hitting or throwing, pushing or pulling, which is applied to an object to initiate or cease movement or to cause changes in movement. The equation to determine is *Force = mass x acceleration (F = ma).* In TT, this can be observed when striking the TT ball with the bat which causes the ball to travel in the desired direction. This can evidently be seen in the Player's video footage where the player is seen, in both Good and Bad shots, applying a forward action to the ball as it nears them, resulting in its movement to the opposition's side.

Turning Forces is the term that refers to the force applied to an object. If it is applied through its centre of gravity it will cause it to move in a straight line which is known as a concentric force.

This relates to TT when looking at a player who strikes a TT ball in the centre of the ball for a simple push/strike hit. Eccentric force is the alternative type of turning force which causes an object to rotate or spin. It occurs when a pivot point has force applied to it to cause an object to change the rotation. The equation is *Moment of Force = Force x moment arm (T = Fd)*. In TT this can be seen when a player attacks the ball. Because it is nearly impossible to hit the ball through its centre of gravity, the turning force will most always be eccentric, however, if you look at the player's intentions, it is an eccentric shot when the player puts spin on the ball and nearly concentric when the player attempts to push the ball try to play with minimal spin. The player, in both shots shown, demonstrates use of eccentric forces due to the nature of the shot the player is trying to achieve; FH *topspin*.

Linear **Momentum** is a term often used in reference to biomechanics which is also known as 'linear momentum' and takes into account both mass and velocity and determines a quantity of motion in a straight or 'linear' motion. It is generally used in sport in regards to collisions and the generation of speed in throwing and striking actions. The equation *is Momentum = mass x velocity (M = mv).* Momentum can be observed in TT when 'attacking' the ball where velocity is gained from the arm swing to target the TT ball; also demonstrated by the player by doing just that.

Impulse is a term that states the change of momentum that occurs when a force is applied to an object such as when the TT ball is hit by the bat. Impulse measures the change of momentum in an object while it is in contact with the 'pushing/hitting' force. It can be measured using the equation *Impulse = Force x time (I = Ft)* The video footage reveals the Player using impulse to change the momentum of the incoming ball and make it an outgoing ball. This is done through use levers to generate a force to return the ball.

Summing Moment is used to advantage in collision or impact situations or when developing speed in particular body parts such as the arms in TT. This is achieved by minimizing the number of body parts used to accomplish a task when only a small of momentum is needed to do so.

Stabilization is required in all striking or throwing skills. It allows a stabilized position to be created which gives the body a solid pivot point around which maximum momentum can be generated. A stable body also allows for increased accuracy as it allows the different body parts to be held in better position. (Williams Page 75) In TT it is important to keep a stable position to accurately return the ball to the desired location, although the featured player does not adequately hold a low and properly positioned body.

Generating Momentum occurs when the body is stabilized. The total momentum in a throwing or hitting action is the sum of the individual moment if different body parts and by generating high momenta a maximum ball and implement speed can be achieved which is critical for developing this. Unfortunately, the player shown does not have their body entirely stabilized to allow for maximum generation of momentum.

Accuracy looks at maximizing momentum/speed which must be balanced by the need for accuracy. Accuracy has two components, the first being height accuracy which, in a throw or hit, can be achieved if release or impact is made at any point on a straight or direct line to the target. The task of the player was simply to return the ball to any part of the opposition's side, therefore accuracy played little importance, however, a small degree was required to land the ball on the table.

4.1.2 Collisions

Elasticity is a biomechanical principle that looks at the collisions between a ball and a striking implement. When a ball collides with a surface, such as the face of a TT bat, it becomes compressed and then expands as a result of the elasticity of the ball. Once it expands back to its original shape it rebounds off the surface. As mentioned, this occurs in TT when a ball is propelled into a bat or the surface of the table. This can be observed when viewing the player's video footage.

Coefficient of Restitution is a term that states that all balls and bats used in sport fall between two extremes of elasticity; perfectly elastic or perfectly inelastic. Simply put, a ball is measured by its bounciness and a bat by the level of springiness it has. Coefficient of restitution refers to the level of elasticity within the implement and can be expressed in the equation:

Coefficients of restitution of different kinds of balls dropped from the same distance onto a firm wooden floor can be seen in the following table.

As can be seen in the table above, the TT ball is very elastic in comparison to the other balls tested.

The '**Sweet Spot**' or centre of percussion refers to the area of the bat that is most desirable to hit. When a player swings their bat, the linear speed will be fastest at the very top of the bat and slowest at the handle. It would seem best to strike the ball at the top of the bat because of the fastest speed generated however, this is not the case. In most sports using a bat jarring occurs when the ball makes contact in either the top or bottom of the bat, therefore, the sweet spot is the area that is free of jarring effects. In TT, because the ball is so very light, no jarring action occurs when it strikes the bat however, the best shots occur from the centre of the bat head as it creates the most desirable path of flight. It is unclear whether or not the player hit the ball in the sweet spot of the bat, however, in the Bad shot the ball was projected in a very unwanted direction which may indicated it hit an edge or other awkward area of the bat.

4.1.3 Inertia

Newton's Law of inertia states that "A body will continue in its state of rest or uniform motion unless acted upon by an applied force." Inertia is the difficulty to get a stationary object moving or a moving object to become stationary. It takes into account aspects like mass, where the heavier it is, the harder it is to generate inertia (get it moving or make it stop). Additionally, the lighter the object, the easier it is to create or prevent movement. Simply put inertia refers to the responsiveness of an object or its resistance to attempts to change its motion. In TT, inertia plays an important role. The TT ball is very light in mass so instant change in movement is done with ease. Also it takes minimal effort to put the ball into movement and to stop it when it is travelling (if the ball needs to be caught).

Rotational inertia is an extension of Newton's Law, discussing the rotation of objects. When an object is rotating on its axis, the object's mass as well as the distance of the mass from the axis of rotation needs to be considered. In TT its rotational inertia can be experienced in the spin of a ball that occurs frequently and in most shots, such as the FH topspin return focused on. Additionally, rotational inertia occurs around the wrist when executing a shot.

Low Rotational Inertia can be defined by the following where the body will be:

- ✓ Less steady
- ✓ Quicker to accelerate and decelerate
- ✓ Easy to cease
- ✓ Responsive to changes in rotational motion
- ✓ Moving fast

High Rotational Inertia can be defined by the following where the body will be:

- ✓ Resistance to change in rotational motion
- ✓ Steadier
- ✓ Difficult to stop
- ✓ Moving slow
- ✓ Hard to accelerate or decelerate

In TT Low rotational inertia is seen in a person who plays shots close to the body and high rotational inertia can be seen in a person who plays wide shots, extending the arm. In the case of the studied player, they demonstrate a relatively medium to high rotational inertia.

Figure 1 – Lever Classes

Inertial speed and **leverage** refers to the importance of differentiating between high speeds that are generated from the decrease of rotational inertia of an object, and high speed generated at the end of a long lever. The lever in a TT swing consists of the hips, the arms, the wrist and the bat.

A **Lever** is "a fixed rod that is rotated about a fixed point or axis". Levers are used when producing rotation of a body segment and to move loads. Levers consist of two forces; an effort force and a resistance force, and two lever arms; the effort arm and the resistance arm. The types of levers are:

- ✓ Class 1 Lever (First Class) – The axis is located between the effort force and the resistance force (see figure 1)
- ✓ Class 2 Lever (Second Class) – The resistance force is located between the effort force and the axis (see figure 1)
- ✓ Class 3 Lever (Third Class) – The effort force is located between the resistance force and the axis

A TT FH is an example of a Class 1 Lever (First Class) as the Lever occurs with the wrist in the middle as the axis of rotation with the arm/forearm and the bat located on either side. The Lever can be shown as *Arm* → *Forearm* → *Wrist* → *Bat*

4.1.4 Balance

Centre of Gravity (CoG) of an object is the point through which its total weight always appears to act, whatever position the object is in. (Williams page 72) The CoG in regular shapes such as rectangles or circles, the weight seems to act through their geometrical centre, so that the centre of gravity is actually in the middle of the object whereas irregular shapes such as the human body and a TT bat have changing positions of centre of gravity. The term Line of Gravity refers to the force of gravity that always acts in a direction that is both downward and vertical. This line originates from the object's centre of gravity. A bad CoG can result in being off balance which can reduce the accuracy and power of shots. Furthermore, a stable position is beneficial and can act as a defense against incoming and unpredictable attacks. By having the body in a position that has a beneficial centre of gravity, it allows the player to be in a more ready state when engaging the opposition.

4.1.5 Projectile Motion

Simply put, a **Projectile** is an object that is propelled into the air by an external force. There are two naturally occurring forces which interfere and affect a projectile; air resistance and gravity.

Air Resistance has an impact on the TT ball as it is very light and easily disrupted, however, due to the small size and smooth surface of the ball, it is not impacted upon too dramatically and TT games are played indoors where air resistance is minimal.

Figure 2 - Angles of Release

There are three factors that determine the flight path of a projectile:

1. **Angle of release**

   The Angle of release of a projectile determines how long the object stays airborne and how far (horizontally) the object moves; it looks at the relation between vertical and horizontal force applied to a projectile. Vertical force gives the projectile longer time in the air whereas horizontal force allows the projectile to travel the furthest distance, with an equal amount of each resulting in an angle projected at 45 degrees, the ideal angle for maximum range covered. Parabolic flight refers to the parabola created when a projectile is thrown with equal horizontal and vertical force (assuming air resistance is non-existent) as it follows a symmetrical curved pathway, where the angle of release is the same at the takeoff and landing (see figure 2). In TT the ball will be affected by wind resistance which will cause it to fall short of its parabolic curve therefore, the recommended angle is an angle at 45 degree or less, usually at 42 degrees. In the video footage it can be seen that the angle of release is below 42 degrees in both shots, with 20.4 degrees in the Good shot and 32.7 degrees in the Bad shot (refer table 6). The Good shot was still successful as the height of release affected the shot.

2. **Height of Release**

   The height of release looks at the fact that not all projectiles commence at ground level and that starting above ground level gives the object greater time in the air making a 45 degree angle an inaccurate angle of release. Therefore, a shot starting higher should have greater horizontal force applied. This has been mentioned in *Angle of Release* which states that the ideal angle for TT is approximately 42 degrees because of the 10 – 30 cm height of

release that is seen. When looking at the player, it can be observed that the Good shot has a height of release of 0.23m and the Bad shot making contact 0.11m above the table top (refer table 5).

3. **Speed of Release**

When looking at speed of release, it can be stated that an increased speed of release will result in an increased distance the object will travel (assuming the angle and height of release are the same throughout). If maximizing the distance traveled is the main objective, speed of release plays a greater role in achieving this when compared to angle of height of release. In TT, the speed of release is less important as players aren't aiming to hit the ball as far as they can. The player was unable to calculate speed of release due to time constraints.

4.2 TT Skill Phases

Preparation

Preparation is just as important as the steps that follow this one. Preparation looks at set up such as stance, bat position and grip. The ideal stance is for the knees and waist to be bent at 90 degree angles with the torso leaning forward. This provides a better base of support and positions the player lower to hit improved shots. Bat position is in front of the player with the bat grip as shown below. Tables 1 – 2 show the player's preparation aspects. The player demonstrates poor preparation in both their Good and Bad shot, however, recommendations in Section 5.0 will address ways in which to improve.

Backswing

For right-handers, the back swing must start with weight being transferred from the left leg onto the right leg which is achieved by bending the right knee. Backswing sets up the timing and power for a shot such as the one the player was analysing, which makes this skill phase so crucial to a successful FH topspin return. As can be seen in table 3, the player shows no signs of backswing in his Good shot and a suitable level of backswing in their Bad shot. This is difficult to analyse as the shot without backswing was successful and the one with backswing was not.

Forward Swing

During the forward swing the order of movement of muscles is similar to in Backswing except with weight transferring from the right leg back to the left leg. Simply put, forward swing is acceleration to 'attack' the ball. The more joints involved when doing so, the greater the acceleration will be. In addition to basic acceleration, the player was required to add top spin

"**Definition:** In TT, topspin occurs when the top of the ball is going in the same direction as the ball is moving, and the bottom of the ball is moving in the opposite direction to the motion of the ball."
http://tabletennis.about.com/od/glossary/g/topspin.htm

Despite the objective, the player showed little signs of creating proper topspin (refer table 4)

Contact

Contact occurs at the moment of impact and determines the way the ball travels. It takes into consideration Angle of Release, Height of Release and Speed of release which have been previously discussed. The player's contact is substantially better in their Good shot (refer table 5 – 6)

Follow Through

Follow through looks at the continued swing of the bat after contact is achieved. From the Backswing until finishing the shot and returning to a 'ready' state the stroke should be continuous and without a break in action. Follow through is dependent on a successful backswing and forward swing. The follow through has many purposed:

- ✓ Prevents loss of velocity at contact
- ✓ Prevents injury that are caused by sudden stopping
- ✓ Provides necessary time to perceive feedback of information (conscious and subconscious)
- ✓ Places the body in a ready position to begin next action.

The player demonstrated appropriate through in their Good shot, with terrible follow through in their bad shot (refer table 7 – 8)

5.0 Recommendation

The player is not at an autonomous stage of learning therefore, they can benefit from methods that lead to improvement in their style of play, including the FH topspin return. Below is a selection of drills that will focus on the improvement of the FH topspin return; drills that will address technique and body position.

Drill: X's and H's

Player A plays the ball down their BH sideline towards Player B's FH corner. Player B plays the ball cross court towards Player A's FH corner.Player A then plays the ball down the other sideline towards player B's BH corner, and Player B hits the ball crosscourt towards Player A's BH corner. Repeat cycle for desired length.

This simple drill allows both players to practice their FH (and BH) returns with both cross court and sideline shots being played. Players should swap roles in the drill to allow for all types of shots to be practiced.

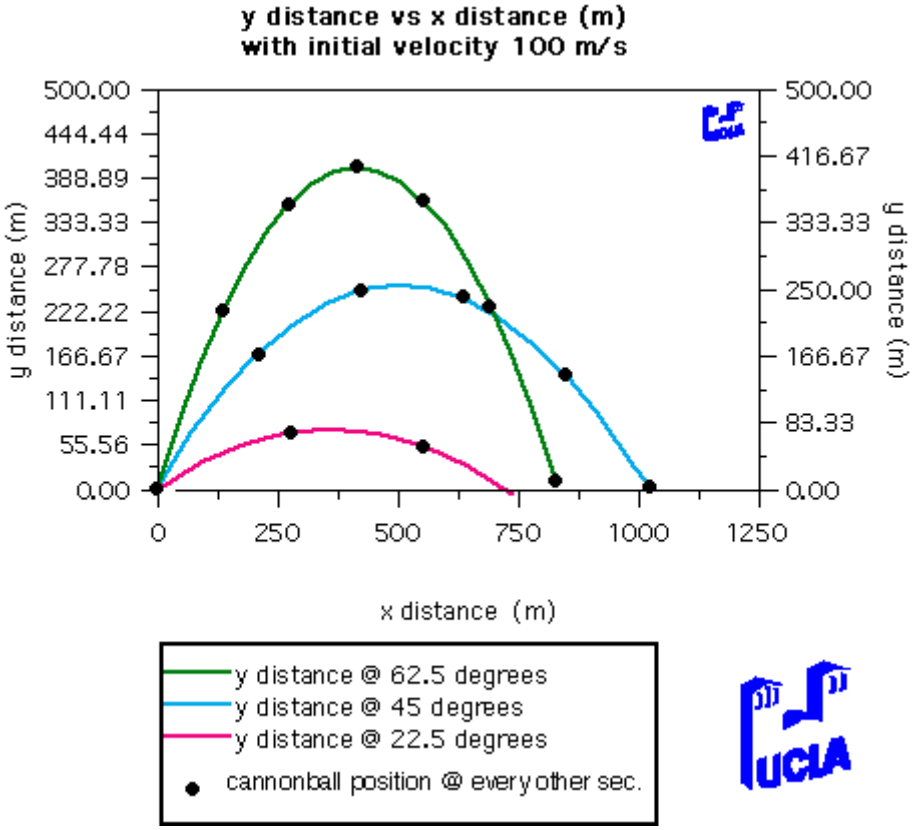
Drill: Keeping the Ball Low

By placing a net post extension on each net post, and running a cord between the two, it is possible to create a simple visual check to see whether you and your playing partner are keeping the ball low over the net.

Allows the player to practice low shots that may otherwise be under practiced.

Drill: Placement Drill – Cross Court

Player A must play all strokes into Player B's FH court (the red area), while Player B must play all strokes into Player A's FH court (the blue area).



This drill will force both players to rethink aspects of the game. Since you know where the ball will be returned and your opponent knows which court to expect the ball the players need to look at consistency in attacking or focusing on power since it is difficult to catch out your opponent. It is still possible to out manoeuvre your opponent with wide balls followed up with a shot straight at the opponent.

Drill: FH Only

Player A must play all strokes with their FH. Depending on the type of drill desired, Player B may be allowed to use both FH and BH, or be restricted to FH only as well.

The idea is to force Player A to play only FH strokes with good technique, so sneaky flipping of the wrist to use BH is not permitted. Player A will receive benefits such as:

✓ Improved footwork
✓ Improved positioning
✓ Accurate placing
✓ Quicker decision making
✓ Increased aggression of play
✓ Increased fitness

Drill: Target Practice

As Player A hits the ball, Player B calls out a number between 1 and 6. Player A must attempt to hit the ball into that location on the table.

Benefits for Player A:

✓ Learning to place the ball rather than deciding at random
✓ Player A improves their ability to 'read' the opponent
✓ Improved judgement
✓ Learn to adjust strokesin different ways to place the ball in different areas of the table

Drill: Two Table Technique

A second half-table is placed on Player A's side of the net, giving Player B access to wider angles which forces Player A to work harder in training.

In addition to the fitness that is acquired through this drill, Player A with be able to practice FH (and BH) shots that require straining stretches to reach. This will increase the player's ability to return more difficult and awkwardly placed shots.

The drills above are mostly with the focus on FH improvement as well as accuracy, general fitness, concentration, strategy and various other relative aspects. In addition to this, the player needs to improve areas of their preparation such as stance, including bending of the knees and waist to get a low position, facing the correct direction, and holding the bat in the appropriate 'ready' position. These issues can be resolved by observing the correct ways and practicing those positions. Further recommendations would be made to the backswing that is not apparent in the player's Good shot. Simple practice will accommodate this issue and a desired backswing will complete the FH topspin return hit to a preferred standard.

6.0 Conclusion

It is clear from this Biomechanics Analysis Report that the role of Biomechanics in sport, and specifically in TT, is important to achieving successful techniques and game play. Biomechanics affects every aspect of TT from body position to striking and reveals that with deep analysis and understanding of these principles, a player can fast track their improvement by knowing how and why certain aspects must be done certain ways. The player's video footage is not exemplary nor is it completely hopeless; however, it is still beneficial for it to be analysed to gain a better comprehension of Biomechanics. The player was able to reflect on the mistakes made as well as the successful elements of their Good and Bad shot. By doing this it allowed the player to easily see where simple errors were made. If the player routinely practices the recommended drills suggested, they can expect to see quick and desirable results. It is through a Biomechanical analysis that this is possible.