

Methods for Obtaining Dynamic Data during Table Tennis Performance

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Introduction

Within recent decades several techniques have been developed for the study of the mechanics of human motion. Improvement in data collecting equipment have enabled us to obtain more specific and accurate data.

Table tennis is a high speed game: it is hard to observe the body action; especially the fast arm movement, during any stroke, without any recording device. The basic strokes in table tennis are the push, block, drive, topspin and backspin. Knowledge of the movements and the workings of each stroke and the various types of spin, speed and power before developing any particular style of game is important.

One of the applications of biomechanics is used to assess the players technique to improve performance. A review of the literature indicates that investigation attempting to examine the body action in table tennis were few and limited in scope.

Renfrew(1) carried out a study on two students of international standard. The students were filmed by a conventional video camera. He compared the success and failures of their service and receive. Unfortunately his work did not provide any kinematic (time, distance, speed, acceleration) or kinetic (forces) information on the performance. Fukunaga, T., et al (2) examined the displacement of the centre of gravity of the body at strikes of topspin (drive) and under spin (cut) in table tennis by means of force platform. Seven males and one female participated in this study. They concluded that the trajectory of the centre of gravity in skilled subjects was a large ellipse, while unskilled subjects indicated a small distorted ellipse of the locus of the centre of gravity.

Others (Shaofa(3); Wu, H.(4); Qiu, Z.(5)) studied the performance of international players, but based their opinions on their experience and observation of outstanding performers.

The aim of this present research , therefore, is to discuss what potential video, cinematography, goniometer, force platform and the accelerometry system have to assess the techniques of table tennis players, in order to demonstrate those aspects to which modification may be desirable to improve performance.

1 - The Video Technique

The use of conventional video cameras is valuable in providing quick quantitative feedback on the table tennis players. But for detailed analysis, the interval between "frames" is limited as the speed of the camera (frequency) can go up 50 frames/sec.

The video analysis of table tennis performances requires at least one VCR set (a timer-mounted camera and a recorder), the camera should be positioned some distance away from the table. As the camera is panned, therefore it is necessary to mark the side of the floor surface in order to measure the distance travelled by the player (either the player segment or the implement).

The researcher recommends the use of video techniques in studying the kinematic of any table tennis stroke if quick analysis is required, as this is a very economic meth-

od. If a precise scientific measurement is required the use of the cinematography is strongly recommended.

2 - Cinematographic Technique

Cine film has been widely used in sports biomechanics in recent decades and its usefulness enhanced by interfacing computers with digitizers. Table tennis performances are recorded on cine film and when the film is projected, information about various timings can be obtained and kinematic and kinetic variables may be calculated. This requires knowledge of both segmental (Clauser et al(6)) and positional data coordinates of the joints (Barune and Fisher(7) Dempster(8). McConville and Alexander(9) and Whitsett(10)).

Cine cameras are easy to operate and capable of high speeds up to 10,000 frames/sec. and of providing accurate time increments. The availability of color film makes it easier to locate the skin markers which are used to identify the player's joints, essential in obtaining accurate displacement data.

The movement of table tennis players is three-dimensional. And in order to obtain sufficient data to analyze performances accurately, it is necessary to film the activity simultaneously from more than one position of the reference frame by putting ground markers on the floor surface. These markers and the cameras should then be aligned with the region.

Cinematography enables the researcher to view the movements of the total body and to relate the body to three-dimensional space. The position of body parts, segmental centers of mass, displacement, velocity and acceleration vectors can be determined. Kinetics of the movement can also be measured indirectly through the formula : $F=ma$ and $T=IL$ where $F=Force$, $M=Mass$, $a=acceleration$, $I=moment\ of\ Inertia$, $T=Torque$, and $L=angular\ acceleration$.

3 - Goniometer

A goniometer is a device for measuring and is often referred to as a protractor. There are a number of goniometers which have been developed over the last thirty years including the electrogoniometer (Karpovitch, P.V. and Karpovitch, G.P.,11) and finally the clinical goniometer (Mie,12).

The main advantage of the electro-goniometer is in the speed of obtaining angular changes during a three dimensional movement. The limitations are the attachment of apparatus and wires to the body which tends to restrict natural movement and the range of movements which may be studied. The newly designed clinical goniometer seems to have minimized such limitations. This type of goniometer is simple and quick to use, extremely versatile, rugged, pocket sized. And it can be used to measure joint mobility in neck, shoulder, elbow, wrist, hip, knee, ankle, spine.

The clinical goniometer is recommended for use if the coach requires quick calculation about the players joint mobility, as this would affect the speed of the stroke in table tennis.

4 - Force platform

The quantitative measures of forces exerted during table tennis performance is an important element in human motion. One way of measuring the internal or the external forces during a performance is the use of a device called the force platform (force transducer). The force platform is a plane surface whose displacement due to a force can be measured to give information about that force. It has been used in sports studies, particularly in track and field, for example (Payne et. al, 13) studied the vertical jump, sprint start and weight lifting and Ballreich(14) used also the force platform to study the running long jump.

In table tennis Fukunaga, T., et. al(2) used the force platform to examine the displacement of the center of gravity of the body at strokes of top spin(drive) and under spin(cut). The main advantage of this system is that the forces are obtained directly and

accurately every few seconds after the stroke is played. The most difficult part of the system is that it requires specialized people to calibrate the whole system. Such a system is recommended for use if the ground reaction forces during a stroke or the path of the center of gravity are required to be examined.

5 - The accelerometry system

This is a newly developed system (Al-Kurdi, 15) comprising of three elements, not a portable telemetry system, accelerometer and recording device.

The accelerometer translates the acceleration applied by the player into an electrical signal which is detected and transmitted via a transmitter fitted to a hip belt. The output signal is then transferred to a computer via analog digital converter.

The advantage of using such a system is that a direct, accurate measurement of acceleration can be obtained and output from the accelerometer can be monitored during the performance. The system is portable, light, wireless and does not inhibit the player during implementaion of a table tennis stroke.

Conclusions

Research in sports biomechanics is conducted by means of instrumentation systems. These systems offer various advantages and disadvantages. The author recommends the use of the accelerometry system in situations demanding immediate measurement of the acceleration of a body segment during table tennis strokes.

Obtaining the three dimensional coordinates of a point in space from a cine film is complex and requires a greater knowledge of mathematics and mechanics, but it enables the researcher to view the movements of the total body. It is a most widely used method in sports biomechanics.

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