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Education; Sport and/or university titles

PhD, FACHPER, FISBS, FAAKPE.

Actual position:

Head of School of Sport Science, Exercise and Health

Other important achievements:

He was the keynote speaker at the 1st World Congress on Racket Sports, the 3rd World Congress of Medicine and Science in Tennis and the last 5 ITF Worldwide Coaches Workshops (2001 - Thailand; 2003 - Portugal; 2005 - Turkey; 2007 - Paraguay; Spain - 2009). He was the organiser of the applied research Projects at the Sydney 2000 Olympics, one of which was on shoulder loading in the tennis serve.

He is a past president (2003-2005) of the International Society of Biomechanics in Sports and sits on the Coaching Advisory Panel of Tennis Australia. In 1999 he was honoured with the **Award of Merit** by the Western Australian Sports Federation and in 2003 the Professional Tennis Registry gave him the **Stanley Plagenhoef Sport Science** Award for "*his lifetime contribution to tennis*" and the Australian Government awarded him their **Centenary Medal** for service to sport policy and research development for sport". The University of Western Australia presented him an award for **Excellence in Research Supervision** in 2006 and **Excellence in Teaching** in 2008.

Published books & articles:

Generally considered a world's leader in research into biomechanics and tennis stroke production he has co-edited the ITF publications *Biomechanics of Advanced Tennis* (2003) and *Technique Development in Tennis Stroke Production* (2009). He has published over 190 articles in refereed journals, as well as over 50 book chapters or books, all in the general area of sports science.

Player Analysis and Improvement Using Biomechanics

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Analysis methods in tennis are generally classified as **subjective or objective**. Most coaches use a variety of subjective evaluation techniques during their normal interaction with players. They watch the forehand action, during a match or under match conditions, with an eye to identifying flaws in technique that may hinder performance or lead to injury. Objective techniques refer to the collection, measurement and evaluation of data (usually video) from the stroke or movement of interest. This presentation will primarily deal with the subjective diagnosis of stroke production, as this is what a coach is required to do on a daily basis.

“The coach who tries to see everything often ends up perceiving nothing”

This is particularly the case for advanced player development, as changes in technique to improve performance may only be very subtle. A structured approach to subjective analysis is essential if one is to become a good coach, especially a good coach of advanced level players. However, coaching is a skill that can be learned through practice (Elliott and Alderson, 2003; Knudson and Elliott, 2003).

Coaches must recognise the following differences in the type of “errors” their players make. The coaching required to correct each “error” would then require a different approach.

- **Error:** Lapse in shot selection - **may require tactically based practice** A player may attempt the correct stroke and miss - **match statistics will tell the coach whether this is a flaw in performance.**
- **Flaw:** This could lead to injury or limit the player’s potential. **This must be treated seriously as performance can be affected.**

The biomechanical approach to analysis and correction has 5 distinct sections.

Step 1: Preparation

- Understand the skill to be analysed, identifying the critical variables associated with ‘ideal performance’.



Step 2: Observation

- Decide on the number of observations needed to ‘make a decision’ on critical variables.
- Observe performance under varied situations (fatigued vs non-fatigued; match vs practice).



Step 3: Evaluation

- Compare critical variables of your ‘ideal performance’ with observed performance.
- Prioritise practice time with regards to strengths in performance and observed weaknesses.



Step 4: Intervention

- Select the appropriate intervention to rectify weakness in performance.



- Provide feedback on the mechanical variables being practised.

Step 5: Re-observe

- Check that intervention strategies have been successful in modifying the movement.

As part of the **preparation stage** some coaches will develop a mechanical model of each stroke, however most prefer to develop a list of key mechanical features.

Typical list of mechanical features for the serve

1. Preparation
 - Grip
 - Stance type
 - Leg flexion
 - Shoulder and hip rotations
 - Ball toss
2. Swing to the ball
 - Leg drive
 - Trunk rotations (forward and shoulder-over-shoulder)
 - Position at maximum external rotation of the upper arm
 - Shoulder internal rotation to the ball
 - Forearm pronation
 - Wrist flexion
 - Kinetic chain
 - Impact position -
 - height of impact – off the ground
 - position of ball re the front foot
 - angle between trunk and upper arm
3. Follow through
 - Internal rotation
 - Path of racket - up and out action
 - Landing foot/balance

Remember, not all sections of your model/list are of the same importance and therefore **key** variables must be identified. While co-ordination of the forward swing may be an essential feature of a service action, other parts may be optional (position of the feet in a “foot-up” or “foot-back” service action). Objective data reported in applied sport science research studies provide the ranges of acceptability for each of the variables in the list.

Examples of these ranges in the serve would be:

- Knee flexion during backswing – $70 \pm 10^\circ$
- Angle of upper arm to trunk at impact – $100 \pm 10^\circ$

While all coaches should view (**observational phase**) each stroke or movement type from different positions, under varying levels of pressure and using different senses (sight, hearing and touch) different coaches may observe performance with a different approach.

- **Directional approach:** Analyse movements starting at the feet and move to the legs-trunk-arm-racket looking for flaws in technique.
- **Performance approach:** An outcome such as the ball being continually hit wide is used as the key ingredient in the search for the flaw in technique.
- **Phasic approach:** Some coaches prefer to look at stroke production during the various phases of a stroke (preparation, backswing, forward swing and follow through).

Most coaches use a **combination** of the above to detect flaws in technique.

In the Evaluation of a stroke the observed responses are then compared with the previously determined desired response together with all the coach's experiences. Flaws in performance are identified and correction strategies established (Intervention).

The aim of the evaluation phase of analysis is to determine the cause of a technique flaw, as opposed to correcting effects that emanate from the original cause, and to determine the best way to correct each flaw.

- **An angle between the arm and the trunk at impact in the serve may not be within the acceptable range (90 - 110°), but the cause of this discrepancy may be related to the angle of the trunk. Trunk angle must therefore be corrected before addressing the issue of the angle between the trunk and arm.**

Before diagnosing any stroke a coach **MUST** acknowledge that flaws in technique may not be mechanically based. They may be caused by: Psychological factors (stress, anxiety), poor tactical decisions (position on court does not permit the selected shot to be hit effectively: previously termed an error), lack of fitness (poor foot movement in positioning for a stroke). The coach to complete the analysis process then re-observes the movement in question to assess the effectiveness of the intervention.

References

Elliott, B., Reid, M. & Crespo, M. *Technique Development in Tennis Stroke Production*, ITF: London, UK, 2009.

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