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Using technology to improve practice and performance: A practical summary

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ABSTRACT

The purpose of this article is to outline the evolution of science and technology within the sport of tennis, while simultaneously providing players and coaches with some specific practical applications that can be utilized by players of all ages and abilities.

Key words: technology, practice, court efficiency, evolution of technology, practical application
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INTRODUCTION

In 2006, tennis witnessed its biggest technological revolution since graphite rackets forever changed the game in 1980 (Lammer & Kotze, 2003) when Hawk-eye technology was officially introduced at the Miami-Nasdaq 100 ATP event. This revolutionary technology not only set a technological precedent within the sport but also served as an invaluable tool for referees, players and coaches, allowing objective observations to be made regarding performance (Boadong, 2014), and essentially opening the floodgates to a barrage of technological innovation.

Technological applicability has unquestionably widened its frontiers to include sports in the 21st century as we can now see technology reigning supreme over institutions such as the World Anti-Doping Agency (WADA), Fédération Internationale de Football Association (FIFA), International Tennis Federation (ITF), Women's Tennis Association (WTA) and the Association of Tennis Professionals (ATP), etc., not only to uphold the regulations and policies of their respective sports (Loland, 2009) but also assist in making enhanced observations and improved data collection (Giblin, Tor, & Parrington, 2016).

Qualitative analysis is the most commonly employed strategy by most tennis coaches to identify and diagnose deficiencies in strategy and technique but this can be problematic due to the rapid speeds at which the game is played (Elliott et al., 2003). Furthermore, strength and conditioning specialists are far too often dependent on a subjective opinion regarding a player's physical status, health and performance, rather than an objective analysis, which can often lead to overtraining, fatigue and injury. The obvious disadvantages with the aforementioned 'subjective analysis' techniques have been widely documented (Hughes and Franks, 2004) and so the urgency within the sport to integrate modern technology has become imperative. According to Omoregie (2016), to better understand how technology assists a sport, it is possible to categorize them into six sub-categories; selftechnologies, rehabilitative technologies, landscape technologies, movement technologies, implement technologies and database technologies.

The purpose of this paper is to illustrate how both database and movement technologies can vastly improve the effectiveness of coaching and player performance on-court, improve physical performance and injury prevention off court, and simultaneously provide some specific training devices while cautioning users to the potential pitfalls associated with the abundance of current information and at our disposal.

TECHNOLOGY 'ON-COURT'

From an on court perspective, coaches primarily focus on two key components of development; maximizing technical efficiency (Schönborn, 2000) so as strokes can be repeatedly performed, and implementing a correct strategical foundation that maximizes the physical and mental capacities of the individual. As much as 75% of all information processed by the brain is in visual format (Williams, 2009) and so the advent of so slow-motion video analysis applications that are readily available on mobile devices, are actively assisting players and coaches alike. Moreover, multiple studies (Jones & Stuth, 1997) have demonstrated that the use of mental imagery (pictures,

video, etc.) combined with physical practice can significantly increase the efficiency of the motor action being acquired.

Practical, cost effective, and easy to use, applications such as 'Coaches' Eye', 'HUDL Technique' and 'CoachMyVideo' are fast becoming ubiquitous amongst the tennis population offering a myriad of popular functions including 'split-screen comparison', 'transparency/side by side viewing' as well as some more esoteric features such as 'timers and chronometers', 'measurement tools', 'joint angles', 'zoom capabilities', 'mirror imaging', 'screen captures' and 'composite picture sequence display' (photo sequencing). More robust options such as Dartfish and Siliconcoach have long been considered the 'gold-standard' of video-analysis as they provide users with a host of additional features such as HD 'video' and match 'tagging' which allows users to view entire matches while simultaneously grouping points in to specific categories such as 'forehand winners', 'backhand errors' or 'aces out wide' so that occurrences can be enumerated and patterns of play from both the subject player and opponent can be ascertained. However, such programs are considerably more expensive and time consuming to use than the aforementioned mobile applications making them somewhat less relevant in today's market.

When attempting to improve a players understanding of the game, implement specific patterns of play or increase general strategic awareness, coaches are relying more and more on statistical analysis and data collection. A staggering 90% of the world's data has been generated in just the last 2 years (ScienceDaily, 2013) and tennis recently demonstrated its commitment to technological modernization as the WTA tour recently partner with SAP analytics to provide 'real-time' statistics and data measurement during matches to assist coaches with game plans and strategy. Additionally, the ITF has implemented detailed match statistics for all main draw matches at its pro-circuit events, which are available (in real time) through its 'ITF Pro-Circuit' application (iOS and Android) allowing many 'transitional' players the unique opportunity to gain insights into their own performance.

With an increased desire for statistics and data, numerous applications have become available for match 'tracking' including Tennis Stats HD, Pro Tennis Tracker, Tennis Trakker, Tennis Math, TennisStats and SmashPoint, all of which provide a vast array of information such as unforced errors, winners, serve %, and break points saved, as well as a multitude of other pertinent information that has become highly regarded and prevalent in professional sports (Haigh, 2009). These applications are typically available for a nominal fee and assist coaches in objectively evaluating performance which is imperative as studies suggest (Franks & Miller, 1991) that a coach's ability to accurately recall events post-match is relatively poor (less than 40%) and so the need for data accumulation has increased. Craig O'Shannessy (2014) has become a modern pioneer of tennis analytics, data collection and strategy implementation as he has emphasized, in particular, the importance of first exchange, and for example how the most commonly occurring rally length (the mode) in professional tennis is just 1 shot.

Qualitative feedback is rapidly becoming more redundant as quantitative analysis is now more accessible than ever providing unbiased objective fact as opposed to subjective opinion. Play Sight has rapidly become synonymous with modern tennis technology as its camera-and-kiosk system transforms a traditional tennis court in to a technological marvel through its interactive touch-screen kiosks, HD cameras, advanced image processing and unique analytical algorithms that provide players with a complete practice/match evaluation that objectively details key areas such as stroke type, ball trajectory, speed ,spin, and player movement and can even offer line calling, real-time video streaming and multi-angle video replays.

Furthermore, a host of companies such as Babolat, Head, Zepp, Yonex, Sony and Wilson are now exploiting modern technology by affording players the opportunity to convert their tennis racket in to an 'analytical machine' through the use of 'clip-on' racket sensors. According to Daniel Becker who is senior marketing manager of Babolat, the built in sensor uses an "accelerometer that analyzes the direction of the racket and a gyroscope that analyzes the rotation of the racket" in addition to "a piezoelectric sensor that analyzes the vibration of the racket to inform the location of the ball on the racquet" (marketwatch.com, 2015).

TECHNOLOGY 'OFF-COURT'

As trainers attempt to increase their athletes overall athletic ability while simultaneously eliminating injury, the quest for a

competitive advantage has crossed in to the strength and conditioning domain. From an athlete assessment standpoint, a useful tool for trainers to utilize is Omegawave; a small portable device which asseses a range of short and long-term adaptational changes that occur in the human body. The device calculates a range of pertinent information including heart activity (ECG), ultraslow brain wave activity (DC potential), neuromuscular fatigue, and reaction rate measurements, all of which can be viewed and instantly analyzed. By monitoring specific changes, trainers are able to modify training protocols as Omegawave's system provides applicable information that can help the athlete improve his/her stress resistance and work capacity, avoid overtraining, and reduce the risk of injury (Fomin, Nasedkin, 2013). All measurements are stored in a cloudbased system that provide results and recommendations that are relevant to the athlete's cardiac, metabolic, Central Nervous System (CNS) and hormonal readiness, which are all primary markers when determining if an athlete is ready to perform successfully at any given time in a season.

From an athlete monitoring perspective the use of Velocity Based Training (VBT) has become the industries primary method for determining strength training load. The 'Push Band' is a wireless wearable device that measures movement velocity via the use of a 3D accelerometer and Gyroscope allowing trainers to instantly monitor fatigue and readiness by identifying reductions in movement velocity and power output. Power is often overlooked by strength trainers and athletes, but strength is only one factor of the equation (F=ma), (Zatsiorsky, 1995), and different strengths have different velocities (Verkhoshansky, 1982) so this portable device ensures that proper development is exhibited throughout the entire force-velocity continuum. A variety of factors such as current training status, chosen periodization model, power, velocity, and average/maximal repetitions are automatically accounted for by said device, and the information generated helps trainers determine optimal loading without relying on the naked eye or rates of perceived exertion (RPE).

CONCLUSIONS

Each of these technological advancements provides coaches, players, parents and trainers with useful information that can significantly alter training protocols, match evaluations, tournament scheduling, injury prevention and more. However the dangers presented are palpable, as now more than ever 'educators' must ensure that their advice is sound, the information they provide is objectively supported, and the interpretation of the collected data is candid, as in the 21st century 'everyone' can readily access detailed information and statistics assuming the role of 'expert'.

Whether using video analysis, power output processors, or any other similar apparatus, it is important to exploit technology in a way that will be beneficial to all members of the sport's industry. Improved data/measurement acquisition and processing, enhanced observations and testing, and improved equipment and training aids alone are not sufficient feedback to substantially improve performance (Giblin, Tor, & Parrington, 2016). An educated interpretation of the data provided by technology will ultimately be one of the most important aspects of the process as we strive for more efficient practice environments (Liebermann, et.al. 2002). The current technological revolution creates unfathomable opportunities associated with it, but also creates an abundance of dangers. Technology and coaching are only effective when there is an established and well defined culture, where disciplined people and disciplined thought co-exist. After all, this is only the beginning.

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