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Authors(s)	Patterson, Matthew, Caulfield, Brian, Conroy, Luke
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BACKGROUND

Biomechanical performance is an important factor for developing tennis players. The tennis serve happens so quickly that it can be difficult for even the trained eye of an experienced coach to identify the miniscule movement differences that can make the difference between being a successful player and not. Traditionally, biomechanical information is captured with an optical-marker system, which is expensive and requires a specialized team to operate (Tanabe & Ito, 2007).

Advances in wearable sensor technology means that it might one day be possible to measure kinematics from sensors embedded in athletic clothing. Currently, there are inertial sensors which can be used in training, but are too cumbersome for an athlete to wear in a game situation. The initial step is to use these sensors to determine what type of information it is possible to get from inertial sensors on the athlete, which is the purpose of this study.

METHODOLOGY

Four athletes were tested with Xsens MTx IMU's placed on their proximal fore-arm and distal fore-arm. One athlete was an elite tennis player (US Collegiate level), two players were recreational and one was a beginner player. Each athlete performed 15 serves and was instructed to serve as fast as possible, but still try to get the ball in. Peak service speed was measured with a Tracker Radar Gun.

RESULTS

Fore-arm rotation rates were measured with the IMU placed on the proximal fore-arm. The magnitude of rotation rates are higher as the level of player skill increases. The time between peak external rotation rate to peak internal rotation rate is faster as well in the more skilled players.

The rotation rate that is being measured on the proximal fore-arm may be indicative of shoulder internal rotation rate. With this in mind, Fleisig et al, 2003 report that the best male tennis players in the world achieve shoulder internal rotation rates of around 2420 deg / sec. In this context the peak rates shown here seem reasonable for a semi-pro player of 2040 deg / sec and a recreational player of 1650 deg / sec. The peak proximal fore-arm rotation rate for the beginner is 700 deg / sec.

It is interesting to note that high acceleration values do not necessarily predict service speed. As well, the two athletes who were traditionally trained had the highest z-y acceleration ratios (3.388 and 4.184 m/s/s compared to 0.206 and 1.226 m/s/s), indicating that some taught factor was the cause of this difference. Higher y-acceleration peaks indicate an increased level of supination prior to ball contact in the non-technique trained group.

DISCUSSION

Placing IMU's on a tennis players arm holds potential for coaches to easily measure biomechanical factors for their players serve. Coaches can use this data to fine-tune elite athletes or to screen younger players for service characteristics that are indicative of a high performance potential in the future.

Such a system could be designed to work on a coaches pda to allow for easy collection and analysis of data. As technology advances, perhaps one day these sensors could be small enough to be unnoticeable by an athlete and could be worn during competition to track performance and cue back to an athlete when their technique begins to break down in a difficult match. Future work will be to validate these findings and create a user interface for a coach to begin collecting such data.

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