PRACTICAL MONITORING TECHNIQUES: USING ONGOING MONITORING TACTICS FOR THE LONG TERM DEVELOPMENT OF ATHLETIC PERFORMANCE

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INTRODUCTION: Long before athletes arrive on the competitive stage, success is partially dependent on preparatory training preceding the contest. Attaining high levels of success, particularly at the elite level, requires near-optimal performances and may be influenced by training. These optimal performances depend on the athlete's physical capability and readiness prior to competition (DeWeese, Serrano, Scruggs, & Sams, 2012). Although training enhances and elicits many biological processes, the ability of the coach to intelligently design training and monitoring plans to enhance performance at critical times is of crucial importance. Additionally, a coach's ability is often constructed on external accolades attained by athletes or teams under their supervision. These are including but not limited to: win-loss record, championship medals, and professional contracts(Côté, Young, North, & Duffy, 2007; Erickson, Côté, & Fraser-Thomas, 2007). While athletic success in sport can be largely attributed to genetic factors (Eynon et al., 2013; Guth & Roth, 2014; Yang et al., 2003), often overlooked are the aspects detailing the effectiveness of training via physiological adaptations. Assessing the effectiveness of training plainly means to understand what underpins athletic performance Evaluating the inputs of the training process then becomes a priority. Thus, athlete monitoring serves to rely on objective information to evaluate the aptitude of the training process and truly appraise success when necessary. Therefore, the focus of this paper will be to discuss implementation of both qualitative and quantitative monitoring strategies serving to aid in daily training decisions. The strategies discussed will allow coaches to monitor the development of athletes within both the day-to-day fluctuations in performance, as well as long term development.

Monitoring: Monitoring information may be successfully applied to instructing athletes and managing training. While pursuing greater levels of performance, the capability of the coach is increased with the collection of information amassed through monitoring strategies (Deweese, Hornsby, Stone, & Stone, 2015). The information amassed will work in favor of the coach and his or her athletes as modifications can now be made at appropriate times within both acute and chronic training schemes. While subjective assessments such as look or feel may provide some feedback on the training state of an athlete, this leaves many important quantifiable measures out of the equation.

When changes to training are made solely on the outcome of performance, many physiological aspects are not considered. This can be viewed as a "Black Box" approach. Within this, the coach knows approximately the input to the box and what was returned (i.e. a performance). As one might discover, this approach leaves much to be desired as the coach has little idea of how training on a physiological level truly transpired. Alternatively, the "White Box" approach allows all factors of training to be examined and analyzed in order to construct educated inferences of why an athlete performed the way they did. The major component of the white box approach, monitoring, involves frequent measures of performance with consistency and reliability (Deweese, Brad H, Serrano, Ambrose J, Sams, 2014).

In its most basic form, tracking training load may provide valuable insight into measuring fatigue levels of an athlete. Fatigue is defined as a failure to maintain the required or expected

force or power output (Gibson & Edwards, 1985). Understanding fatigue throughout the season plays an important role in decisions regarding training during the competitive season. This not only provides a "self-check" for a coach's training practices, but also helps prevent an athlete from overtraining. In the last 8 Olympics the difference between standing atop the podium with a gold medal (1st) and being omitted from the podium, (4th) was decided by less than 1.5% (DeWeese et al., 2015a). Moreover, the difference between first and fifth place in a sprint can be hundredths of a second, therefore seemingly trivial disruptions in training may have large consequences (McCann, 2008).

A coach's understanding of how training may affect performance is of high importance, as previous studies have found strategies to elicit performance improvements between 3 and 6% (Mujika, Padilla, Pyne, & Busso, 2004). Although these studies were conducted with throwing and distance athletes, this evidence supplants the importance of understanding training theory and the biological processes governing performance and suggest certain strategies could potentially take an athlete from merely being in the final to winning the gold medal. The greater number of objective variables that a sport scientist is able to quantify in training can help to provide greater insight into the necessary steps required to elicit higher levels of performance in competition.

Tools for Monitoring.

The complexity of a monitoring program is dictated majorly by the resources available to the sport coach. This focused on the monitoring of a Division I volleyball team throughout a competitive season to serve as an example of appropriate athlete monitoring. Volleyball is a sport characterized by frequent short bouts of high-intensity movements. These include sprinting, jumping, diving, change of direction, blocking, and hitting (Polglaze, 1992; Sheppard et al., 2008; Viitasalo, 1987). Due to these characteristics, a number of physical and performance variables are important to volleyball. These include maximum force, power and rate of force development (Ferris, Signorile, & Caruso, 1995; Fleck, Case, Puhl, & Van Handle, 1985; Gladden & Colacino, 1978). The authors of this paper used several approaches to the monitoring of these variables: Pre-season and post-season performance testing, weight room volume loads, countermovement jump variables (jump height, net impulse), session ratings of perceived exertion, training intensity, injury reports, and most practically, personal communication with the sport coaches and athletes themselves. The combination of all monitoring tools described above provides basis for sport training and provides a clear view of multiple aspects of training. Instead of speculating as to the determinants of a specific performance, the sport scientist can return to tangible monitoring data to make an evidence-based decision on why performance was affected. Utilizing this data and being in constant communication with the coaches, athletes, and athletic trainer leaves no stone unturned with regards to training.

Interpreting the Information Collected: One obvious fallback to the quantity of the collected monitoring data is that many coaches do not know how or when to interpret the information collected. This is where the sport coach must work in conjunction with sport scientists to help make decisions on training. The sport coach knows best how to elicit the greatest performance out of an athlete or team, but the sport scientist understands the physiological underpinnings of why training elicits certain responses. The authors of this paper utilized PASCO scientific portable force plates to perform weekly jump monitoring. Based off of the findings in (Christopher Sole, Mizuguchi, Kimitake Sato, Moir, & Stone, 2015; Mizuguchi, n.d.), countermovement jump variables may help indicate readiness to perform for volleyball athletes.

This is done through magnitude based inferences and statistical process control following the collection of countermovement jump data (Hopkins & Pyne, 2004). The ongoing monitoring of countermovement jump variables allows for the analysis of objective measures of fatigue and preparedness without adding extra stressors to the athlete. Data collected from ongoing monitoring along with communication to the coach allows for a much clearer view of the training process as a whole. Not only will this aid in the development of the athlete, but it fosters good communication between the coach and sport scientist. This communication is vital for the success and continuation of any monitoring program. The authors of this paper have used countermovement jump monitoring as a tool for preparedness, but the application across sporting disciplines is clreear. The application of consistent weekly monitoring highlighted in this paper may be utilized by many team sports and individual athletes in training. Furthermore, the needs of the athlete or team being examined must be met with sport specific tests elucidating adaptations to training, respective of the physiological demands of the sport.

CONCLUSION: Regardless of the information presented in this brief exploration of monitoring tactics, the question arises: will monitoring my athletes in this way provide more wins? A valid question that is met with an honest answer: Not exactly. There is no guarantee monitoring athletes will improve their performance. If the goal is to win at the expense of an athletes' development and growth, then monitoring serves very little purpose. If that goal changes to the long-term development of an athlete to reach his or her genetic ceiling, monitoring serves to pave a path forward for continued development. The goal of a sport coach is to foster an environment where the athlete has the greatest ability to succeed. Ultimately, monitoring should be guided by communication between the coach, sport scientist, athletic trainer, and athlete to provide the most stable platform from which to enhance sport performance.

REFERENCES

Christopher Sole, by J., Mizuguchi, S., Kimitake Sato, C., Moir, G. L., & Stone, M. H. (2015). Analysis of Countermovement Vertical Jump Force-Time Curve Phase Characteristics in Athletes.

Côté, J., Young, B., North, J., & Duffy, P. (2007). Towards a Definition of Excellence in Sport Coaching. *International Journal of Coaching Science*, *1*(1), 3–18. Retrieved from http://www.researchgate.net/publication/236124942_Ct_J._Young_B.W._Duffy_P.__North_J._(2007)._Towards_a_definition_of_excellence_in_sport_coaching._International_Journal_of_Coaching_Science_1_3-18

Deweese, Brad H, Serrano, Ambrose J, Sams, M. (2014). Sliding to Sochi Part 1: Review of Programming Tactics Used in 2010-2014 Quadrennial, 18–19.

Deweese, B. H., Hornsby, G., Stone, M., & Stone, M. H. (2015). The training process: Planning for strength–power training in track and field. Part 2: Practical and applied aspects. https://doi.org/10.1016/j.jshs.2015.07.002

DeWeese, B. H., Serrano, A. J., Scruggs, S. K., & Sams, M. L. (2012). The Pull to Knee—Proper Biomechanics for a Weightlifting Movement Derivative. *Strength and Conditioning Journal*, *34*(4), 73–75. https://doi.org/10.1519/SSC.0b013e31825f9e7b

Erickson, K., Côté, J., & Fraser-Thomas, J. (2007). Sport Experiences, Milestones, and Educational Activities Associated With High-Performance Coaches' Development. *The*

Sport Psychologist, *21*, 302–316. https://doi.org/10.1080/10413200390180035

Eynon, N., Hanson, E. D., Lucia, A., Houweling, P. J., Garton, F., North, K. N., & Bishop, D. J. (2013). Genes for elite power and sprint performance: ACTN3 leads the way. *Sports Medicine*, *43*(9), 803–817. https://doi.org/10.1007/s40279-013-0059-4

Gibson, H., & Edwards, R. H. T. (1985). Muscular Exercise and Fatigue. *Sports Medicine*, *2*(2), 120–132. https://doi.org/10.2165/00007256-198502020-00004

Guth, L. M., & Roth, S. M. (2014). Genetic influence on athletic performance, *25*(6), 653–658. https://doi.org/10.1097/MOP.0b013e3283659087.Genetic

Hopkins, W. G., & Pyne, D. B. (2004). SPORTSCIENCE sportsci.org How to Interpret Changes in an Athletic Performance Test. *Sportscience*, *8*, 1–7.

Mizuguchi, S. (n.d.). Net Impulse and Net Impulse Characteristics in Vertical Jumping. Retrieved from http://dc.etsu.edu/etd

Mujika, I., Padilla, S., Pyne, D., & Busso, T. (2004). Physiological changes associated with the pre-event taper in athletes. *Sports Medicine*, *34*(13), 891–927. https://doi.org/10.2165/00007256-200434130-00003

Yang, N., MacArthur, D. G., Gulbin, J. P., Hahn, A. G., Beggs, A. H., Easteal, S., & North, K. (2003). ACTN3 genotype is associated with human elite athletic performance. *American Journal of Human Genetics*, *73*(3), 627–631. https://doi.org/10.1086/377590