The role of Biomechanics in High Performance Sport

Is there actual value in this component of sport science?

Text: Jaco Liebenberg, Sport Biomechanist, hpc

First things first. What is Biomechanics? Biomechanics is the area of sport and exercise science where the laws, principles and methods of mechanics are applied to the structure and function of the human body.

That being said, **why** do coaches and scientists study and investigate biomechanics in high performance sport, and what is the role of a Biomechanist?

Let's start with uncle Newton. Newton's Laws are physics-based rules that determine how an object moves through space. These laws are set in stone. Athletes are nothing other than complex objects that moves through space. Consequently, Newton's laws will determine how each athlete will move during a specific task. (Considering all other factors influencing performance stays **equal**). It's important for coaches and athletes to know that when technical coaching and analysis is being done it should be based on facts (laws of physics) not only on personal opinion and insight. During a scientific and detailed analysis a skill is broken down into its fundamental components in order to find any movement error in the technique that may lead either to injury or a decrease performance, or visa versa. Importantly, the opposite can also be true by obtaining information on what a certain athlete are doing right relative to a specific movement. Below are a few specific steps on the approach taken during a biomechanical analysis:

1. Literature Review: First but foremost, a proper literature review is done to reinsure that the sport scientist got a proper understanding of the relevant biomechanics of the sport code. This is a component that is often neglected in both the coaching and sport science realm of biomechanics. Due to the large amount of data being collected today, the sport scientist's roles are to gather, filter and apply any new 'findings' to a specific athlete or athlete group. Despite this, certain basic biomechanical fundamentals (Newton Laws) will never change irrespective of any "new" findings.

2. Utilization of Data: Detailed data does not only need to be collected, but more importantly, it must be correctly utilized and analyzed to promote performance. Biomechanical data can be used in different ways.

a. *Norms and Standards*: Normative data is one of the key components in utilizing biomechanical gathered data correctly. Over the years copious amounts of technical data has been collected on elite performances and what sets elite athletes apart. This normative data provides the foundation from which to assess the validity, accuracy and value of newly collected data relevant to performance.

b. *Within Subject Trends*: It is important to acknowledge that each individual athlete is different, despite the normative data available. Biomechanical data tracking enables the sport scientist to investigate if any technical trends are present in an athlete's technique which in return can be correlated to specific performance levels. For example every time athlete X performs well, certain biomechanical characteristics/ trends are present that are unique to athlete X, irrespective if it falls within the norms and standards or not. These trends can provide valuable information on where to make biomechanical changes that are relative to each individual athlete's technique. Athlete X may be stronger in utilizing parameter 1 to reach a certain outcome compared to athlete Y that utilizes parameter 2 better in reaching the same goal.

c. *Newton's Laws relative to the coaches' eye*: As previously mentioned, a large part of elite performance is determined by how well you can apply "Newton's Laws" to your sport specific movement. The main difficulty, especially with technical events, is that it is mostly impossible for the coach to see how well "Newton's Laws" are implemented during an event, i.e. exact ground contact times, average vertical push-off, recovery time from take-off to max knee lift, etc. An experienced coach often had a

good "feel" as to how well these parameters are executed, but overall it is close to impossible to gather such information with the naked eye. This is exactly where biomechanical data capturing comes in to place. Biomechanical data capturing provides the opportunity to access data that was previously unavailable and make informed technical coaching decisions.

d. *Between Subject Trends:* Biomechanical research also provides the coach not only with technical information on how to possibly increase performance, but also technical information on what the possible biomechanical reasons are for specific players to reach higher levels of performance compared to others. It's not always about finding a method on how athletes can technically reach a higher level of performance, but more so on **why** certain athletes reach a higher level of performance than other. If biomechanical research can assist in finding possible technical reasons for an increase in the level of performance by certain players, coaches may use this information by incorporating some of these technical components on to other athletes with goal to increase performance.

e. *Relation to injury:* Coaches want players to be in a physical condition where they are able to perform at

their highest level of performance. By analyzing players through mechanical testing, Biomechanist's can provide supplementary in-depth technical information and data to a coach and strength and conditioning specialist on what the possible cause might be for players obtaining certain injuries as well as possible prevention methods for other players not to obtain the same injuries. This information and data are not always possible for coaches to observe with the naked eye, but biomechanical research can make such observation possible. If coaches have the edge by having direct access to this kind of information, they can, **together** with a full medical and conditioning team adapt training and coaching methods in such a way where an attempt can be made to reduce and prevent injuries in a group, team or individual player. One of the questions to be answered through biomechanical research is whether the **perceptions** of what causes injuries in elite players are indeed the true cause for injuries or not.

3. Data Tracking: Looking at the broader picture, one of the more important components in biomechanical analysis is to use the test data to track and determine success. Is the athlete able to adjust and implement new biomechanical requirements?

It is CRUCIAL to remember that it is one thing to find mistakes or areas for improvement through biomechanical testing, but it is something else to teach the athlete how to successfully make changes. This is where the KEY to success lies; you need a GOOD coach who will be able to make these changes successfully. The only way to track changes is by continually repeating the same protocol after optimal time periods are given for motor learning. At the same time it is important to know that the athlete needs adequate time to learn and apply changes.

In conclusion, it is important to understand that the role of a Biomechanist is not to dominate and change the way coaches coach players, but rather to provide technical assistance in such a way that coaches have access to in-depth technical knowledge and information they would not have had previously, ultimately giving them the ability to improve technical coaching at **their discretion**.