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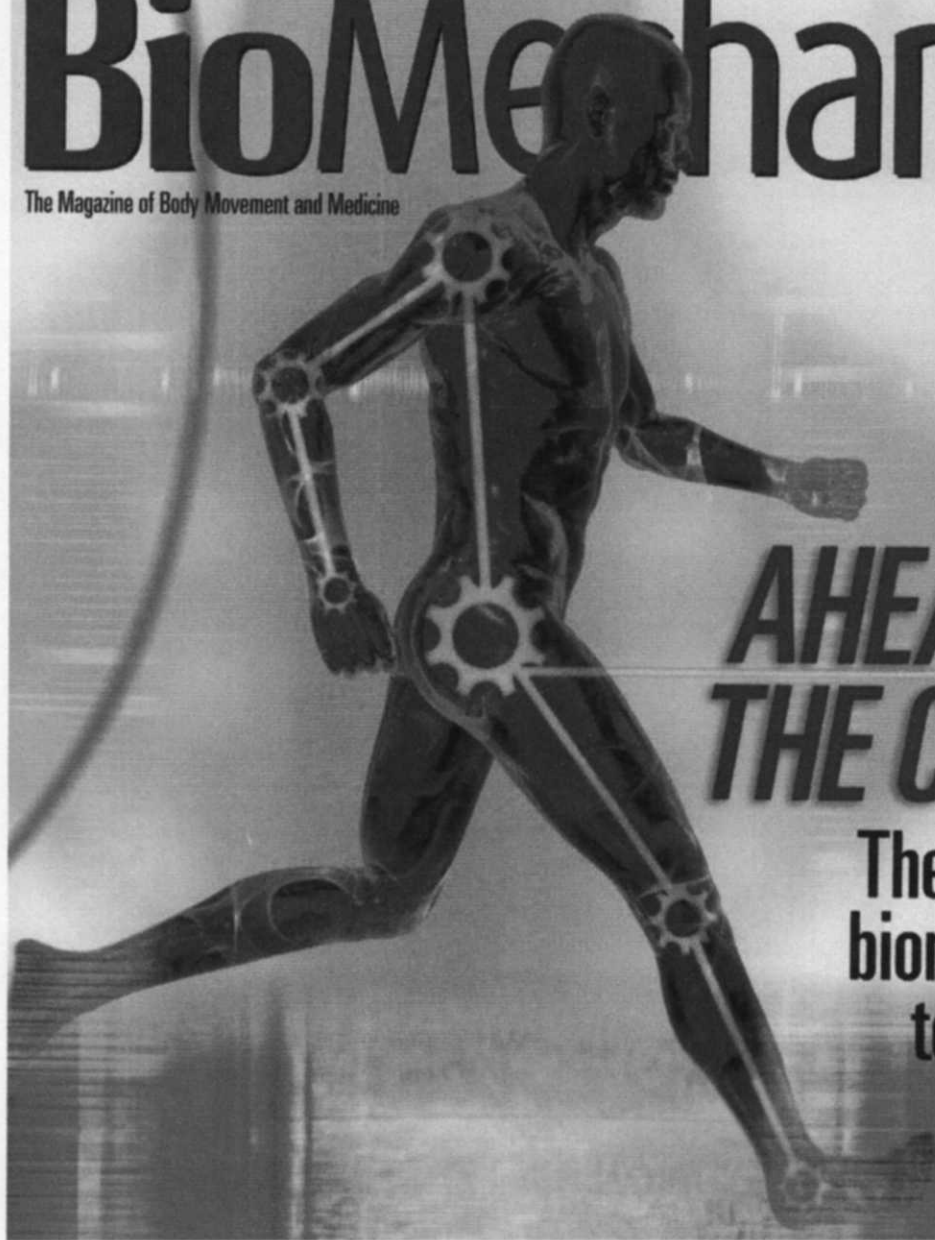
Tackling football injury prevention

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An intensive 'prehab' program based on 3D motion analysis provides data that can help prevent career-ending injuries.



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3D motion analysis gives collegiate quarterbacks an edge

Repetitive motion injuries can occur in any sport. To help prevent injuries and improve performance in athletes, coaches and trainers have relied on technology—usually in the form of videotape analysis of athlete movement and biomechanical performance assessment. Golfers and baseball players, in particular, have benefited from this type of testing. Video analysis has its limitations, though, because the camera allows for viewing only from a single angle.

by Lindsie R. Klingman, RN,
and Leslie R. Jebson

'Prehab' is a combination of training performed in an optimal manner and the proactive identification of muscular or biomechanical deficits through 3D motion analysis.

Fast forward to 3D motion analysis, considered by many in the sports medicine field to be the optimal methodology for examining athletic performance. High-speed analysis using multiple cameras not only helps players who have been reliant on feedback gained from conventional video analysis, but it can also be applied to a broader range of sports, including volleyball and football.

Football players require a great deal of strength training and conditioning to give them enhanced strength, power, speed, and agility they need in order to be successful. With increases in training and game time and the physical nature of the sport, players are often susceptible to injury. The prevention of injury and the enhancement of game performance are at the forefront of scientific advancements in musculoskeletal care.

Because quarterbacks, in particular, are likely to suffer both contact and throwing injuries, they lend themselves well to additional study. Shoulder injuries are the second most common injury for quarterbacks, right behind head injuries. In a study of 22 National Football League seasons, 1534 quarterback injuries to all body parts were reported.¹

Among the injuries, 15.2% were to the shoulder; of those, 14% were related to throwing. The most common throwing injuries were rotator cuff tendinitis and biceps tendinitis. The amount of lost training and playing time for rotator cuff tendinitis was a mean of 15.3 days, and for biceps tendinitis, the mean was 19.3 days.

While injuries such as these occur with frequency among NFL players, collegiate athletes may also suffer from these and other similarly related injuries. Younger athletes may suffer from different injuries related to inferior muscle strength, poor throwing mechanics, and increased contact forces, according to the NFL study authors.¹

Regardless of differences between professional and collegiate playing styles, quarterbacks are exposed to similar mechanical stresses. Injuries can occur from overhead throwing motion. Although the football throw is similar in some respects to other overhead throwing motions, such as those found in baseball, the increased weight of the football appears to affect shoulder position and stresses throughout the throwing motion.

Putting prevention in rehab

At the turn of the 21st century, a new training program, coined "prehab," was developed among a growing number of universities and professional sports teams. The objective of prehab is to forecast and prevent injuries that may occur during the sports season. In 2003, Ohio State University developed a prehab program that consisted of exercises to strengthen the four areas most prone to injury in collegiate football players: shoulders, backs, ankles, and the hamstring muscles.²

Prehab has evolved since that initial training program at OSU. Today, prehab is a combination of training performed in an optimal manner and the proactive identification of muscular or biomechanical deficits through 3D motion analysis. This form of motion analysis allows coaches and trainers to view any of the player's actions that may create stress-related or repetitive motion injuries and is an integral component to any comprehensive prehab program.

The University of Florida Orthopaedics and Sports Medicine Institute contains one of the largest 3D motion analysis laboratories in the country. The Biomechanics and Motion Analysis Laboratory consists of 12 infrared cameras that can capture images at 500 frames per second. These cameras work in conjunction with plates in the floor. Researchers and therapists use the cameras to measure the force that the feet and body exert

on the ground during specific movements.

Before the analysis begins, 22 reflective tape markers are attached to key locations on an athlete's body. As the athlete performs the repetitive motions that pertain to his or her sport, the cameras record the movements made and feed the information into a computer program, which creates a 3D image of the athlete. The laboratory engineers measure the movements and angles of the athlete's body and then later review the data with the coaches and athlete. In this way, they come to better understand the motions that may create an injury later in the season.

This analysis not only diagnoses potential issues, it can also illustrate ways in which an athlete can improve his or her performance. A well-documented example is the use of such motion analysis capabilities with elite collegiate quarterbacks.

Athletes who use throwing motions in their sports gain power from hip and trunk rotation.³ If these athletes do not take full advantage of that rotation, they may experience problems.

During the 2007 season, after a star UF quarterback complained of shoulder discomfort from performing several passing motions, he was brought into the laboratory for a 3D analysis. Coaching staff and laboratory engineers were able to determine that he had been using too much of his lower arm to throw the football. They then helped him alter his passing technique.

Once the change was implemented, repetitive motion stress on the player's shoulder was reduced and a quantifiable improvement was seen in his passing performance.

Prehab in motion

The UF football program then decided that all quarterbacks would undergo comprehensive 3D motion analysis before the start of each season. In this way, they could

identify postures, movements, and motions that could result in repetitive motion injury. Based on the findings of the analysis, the coaches could create an individual training program to alter a player's kinetics to prevent injury and possibly improve performance.

Each year, this information is compiled into a database to be reviewed annually in combination with each quarterback's statistics to determine if 3D motion analysis sessions are needed in the future.

Although 3D motion analysis can improve performance and reduce injury, many factors must be taken into consideration before implementing such an offering in a sports program. Appropriate placement of the reflective markers on the athlete is one issue. Some motion analysis scientists are developing protocols to ensure that the markers are always placed in the same specific location each time the athlete gets tested.⁴ This could avoid the possibility of a skewed analysis if the markers are not placed in the exact same location each time.

lete may miss a session because of injury or illness, but as soon as he or she has recovered, an analysis should be performed as close to the scheduled time as possible.

Preventing injuries is essential for collegiate football athletes. The NFL completes a study each year to determine the likelihood that a collegiate player would make a good candidate for a league career. The ability of the player is evaluated and the anticipated duration of such a professional career is calculated. The process includes an evaluation of the athlete's physical ability along with a review of his medical and imaging history. Issues such as anterior cruciate ligament injuries and/or reconstructions, knee meniscal injuries, and shoulder instability can all prevent the collegiate athlete from continuing to the NFL.

A study showed that although 80% of running backs and wide receivers with ACL injuries were able to return to play, their performance was reduced by one-third. It is believed that shoulder instability and other injuries could produce similar percentages.⁶

A history of these injuries can decrease the likelihood of a player pursuing a professional football career.

When examining the performance of a collegiate football player, an intensive prehab program that includes 3D motion analysis is essential. Not only will such a program improve the athlete's performance, it can help prevent career-ending injuries caused by repetitive motion stress.

Three-dimensional analysis is a relatively new aspect of athletic training and is an integral part of the prehab process. With the establishment and evaluation of programs similar to the one at UF, further benefits to quarterbacks and other collegiate and professional athletes may be discovered.

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TAKE-HOME POINTS

- Shoulder injuries are the second most common injury for quarterbacks, right behind head injuries. The weight of the football appears to affect a quarterback's shoulder position throughout the throwing motion.
- The objective of prehab is to forecast and prevent injuries that may occur during the sports season.
- The use of 3D motion analysis in a prehab program allows coaches and trainers to view any of the player's actions that may create stress-related or repetitive motion injuries.

Another issue is calibration of the machines. While most laboratory engineers probably calibrate the equipment based on the manufacturer's guidelines, experts recommend that this take place before each session in order to yield the most accurate

data collection.⁴

To accrue the complete benefit of 3D motion analysis, experts also recommend that athletes get monitored on a regular schedule, such as during the same month each year.⁴ Adherence is important. An ath-

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