Lower Extremity Function and Body Control in the Athlete

Potential Application in the Equestrian Athlete

BY MIKE PILATO, MSAT,C

Riding a horse is no less an athletic activity than other more common sports. Yet while science has an understanding of body control in these other sports, body control in the riding athlete from a scientific perspective is not well understood. The purpose of this article is to:

1. Present the basic concepts of body control
2. Stimulate discussion as to their application to the riding athlete so they may be better able to maintain their center over the horse's center.

Those interested in a more in-depth and technical description of rider stability, please go to http://www.equicision.com/StartHere.html.

Concept One:

With rare exception (i.e. swimming), the foot is the Base of Support (BoS) in athletic endeavor.

In regular standing posture (P2) the entire foot is used to support and manage the forces acting on the body.

Elevating either the heel or toe shortens the base and alters how the body manages these forces. In this example a block of wood is placed under the ball of all 5 toes (shorter BoS) to highlight the effect of the shorter support surface on regular standing posture (P1 & 3).

Regular standing posture.

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The body's Center of Mass (Gravity) is focused within the foot in the area called "Center of Pressure (CoP)". CoP changes slightly within the foot based on body position and stance width. In "regular standing posture" CoP is around the area of A. As stance widens (most applicable to riding) CoP shifts back and out (Position B)

Concept Two:

Because the foot acts as a pivot point over which the body moves, the body can be thought of as an inverted pendulum (P5). If the body's Center of Mass (Gravity) goes beyond the base of support afforded by the foot, the body must create a counter movement to either stabilize its Center of Mass or continue moving in the direction of its Mass. The arms are often used to create this countermovement. In this example, leaning back creates a forward movement with the arms (P6) and leaning forward creates a backward movement with the arms (P7).

Concept Three:

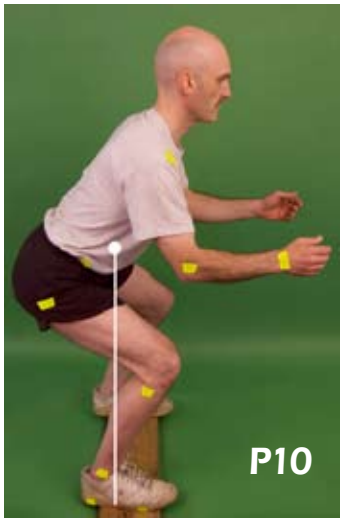
The stirrup, stirrup leather and saddle make up the support system for the foot. The foot functions optimally on a firm, full-sized, stable base. The width of the average stirrup, while a firm surface, utilizes only 10-15 % of an average foot length. The leather, while making the length of the system somewhat consistent can pendulum back and forth. The saddle while firmly secured to the horse is influenced by the horse's movement. Finally, the horse itself is a multi-directional unstable surface (normal roll, pitch and yaw during gait).

Concept Four:

Lower extremity Closed Chain Mechanics: A "closed system" describes a system where the distal end of the body (in this case the foot) is set against a firm, fixed length and stable surface. An open system describes a system where the distal (far) end of the body is free to move.

This first series of pictures (P8, 9, 10) describes the normal "accordion style" timing mechanism used to maintain the body's CoM over its BoS. The lower leg moves forward over the foot through coupled ankle and knee motion, the upper leg folds back and down through coupled knee and hip motion and the torso moves over the upper leg through coupled hip and spinal motion.

In this second series of pictures (P11-16), the effect of the common "heels down" position is illustrated. As noted above, forward movement of the lower leg is needed for normal accordion style timing function. However as the heel is lowered



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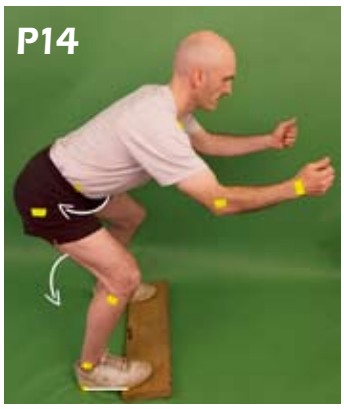
(P11), range of motion available at the ankle joint decreases. This results in the knee moving out over the toe to counter the pull of the calf muscle.

The compensation for this is less bend at the knee, increased forward lean at the torso and increased arm counter-movement to counterbalance the backward motion of the bodies CoM (large dot) (P13-15).

Note the difference in joint angles' between pictures 15 and 16.



Concept Five:

Gender Differences in Lower extremity mechanics and the Position of No Return

While the joint mechanics are similar between men and women, torso, hamstring and hip abductor (outside hip muscles) muscle function is different. These differences tend to produce a "less efficient" posture when it comes to managing lower extremity forces. In sports medicine, this is the "Position of No Return"

P17 illustrates the common "knee over toe" position utilized by females.

P18 illustrates the common "knee over foot" position utilized by males.

As males go up and down (posting) the knees tend to stay over the feet, there is increased use of the hip joint and the knee stays on a line drawn between the foot and hip. Females on the other hand tend to have

the knees go out over the toes and inside a straight line drawn between the foot and hip (P17A, 18A).

Readers are encouraged to try this test for themselves. Simply place the balls of all 5 toes on a block two inches high, keep the heels on the ground, and perform a release motion. Then take the blocks away and attempt the release motion from a flat foot position.

In closing

The scientific knowledge for human movement and performance is always increasing. Coaches in turn have used this knowledge to modify and tailor their teaching of sport specific skills to their athletes. To this point, the majority of research has focused on improving the equine athletes performance. This article provides knowledge useful to the instructor for improving HUMAN performance on the horse. It is hoped this article will stimulate further discussion about how this knowledge can be used to improve equestrian athlete performance.

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Mr. Pilato has been a certified athletic trainer for 20 years. In 2003, he began mentoring under Drusilla Malavase and Doris Bixby Hammett to apply his sports medicine based research to develop the concept of the equestrian as an athlete. Since then, he has presented at the USPC National Meeting, as a guest speaker for the British Horse Society and was a panelist for the USEA Safety Summit.

He has published 3 books specifically for the equestrian athlete, several articles for the EMSA newsletter and other US and international horse magazines and developed programs for improving equestrian athlete performance/fitness, and minimizing risk of injury from falling. His ongoing research includes rider injuries/injury patterns, sport mechanics and how gender differences influence sport performance.