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guest editorial

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NonContact ACL Injuries in the Female Athlete

Prevention Programs Based On Injury Positions

THE IMPACT OF BASKETBALL players tearing the anterior cruciate ligament (ACL) is great financially and personally. In addition to the financial impact, the potential changes on the athlete are lifelong ones. For college athletes, the estimated cost for ACL reconstruction and rehabilitation is $4.6 million for the female and $1.5 million for the male for basketball alone. These estimates are based on extrapolation from NCAA Surveillance System of ACL injured basketball athletes for one year of 273 females and 91 males.[1]

In basketball, the female has a four times greater chance of tearing her ACL than the male. According to NCAA statistics, over the last 10 years the injury rates have not changed.[2,3] Why? To an outside observer it would appear that improved conditioning and participation at an earlier age, better skills and equipment, and more effective coaching would result in a reduction in injury rate.

There are obvious static differences in anatomy in the female compared to the male.[4,5] The more important factors in ACL injuries are movement patterns-the way the athlete moves, jumps, lands, and cuts. We all have seen the aggressive and very competitive athlete. We worry about her ACL. ACL tears captured by videotape in basketball allow us to see this high risk position, more upright, hip internally rotating and knee in valgus. When rebounding on offense, the rapid stop, cut, or change of direction is followed by a whiplike motion of the knee. The ACL fails just prior to the gross position of the knee.

Anatomically, the female has a wider pelvis, increased femoral anteversion, valgus knee, externally rotated tibia and prorated foot. (Fig. 1) Comparing the sexes, the position and control of the trunk, low back and pelvis are also different. The female has an anteriorly tilted pelvis, greater lumbar lordosis, and subsequently greater hip internal rotation and adduction. (Fig. 1) This pre-existing position allows a more awkward landing from which the athlete cannot recover. This is the "position of no return."[6]

Learning from the observed "position of no return" gives us clues to the kind of training programs which should be instituted for prevention. The training programs should focus on landing on a more bent knee and bent hip and the spine and pelvis in neutral position-hips over knees, knees over 2nd metatarsal. The high risk position is uncontrolled, more extended or upright, hip inter-

nally rotated and knee in valgus, tibia externally rotated and prorated. We can also think about the muscles which are protective (agonistic) and the muscles which fire to accentuate this position of no return (antagonistic). (Fig. 2) Basic science studies are needed in landing patterns and joint kinematics. Research dollars are needed to fund these prospective multicenter studies.

Well designed funded studies must be implemented. We should develop a perturbation box for the athlete. Have her play offense or defense against another fictional player in virtual reality style. Warn her of high risk positions. Train to know how to fall, land, and move and get down and stay down. It is difficult to promote programs to coaches which reduce injury; however, acceptance is greater if the program improves performance. Hewett et al have been able to have coaches buy into the program if they result in improved performance, e.g., greater vertical jump.[7] The risk of injury was also less in the trained group.

We know the injury rate in basketball is significantly greater in the female. We must determine the causes. Static differences and hormonal influences are not the most important causes. Dynamic movement patterns must be evaluated by EMG, high speed motion analysis and force plates.

Multicenter prospective studies must be designed and funded. A well designed prospective study of a population of young athletes in basketball followed over approximately five years is needed. The level could be high school or college. The rate of ACL injury must be determined in the group, then an intervention program is started. The program would include balance, strengthening, and position awareness. Get more flexed. Get down! ■

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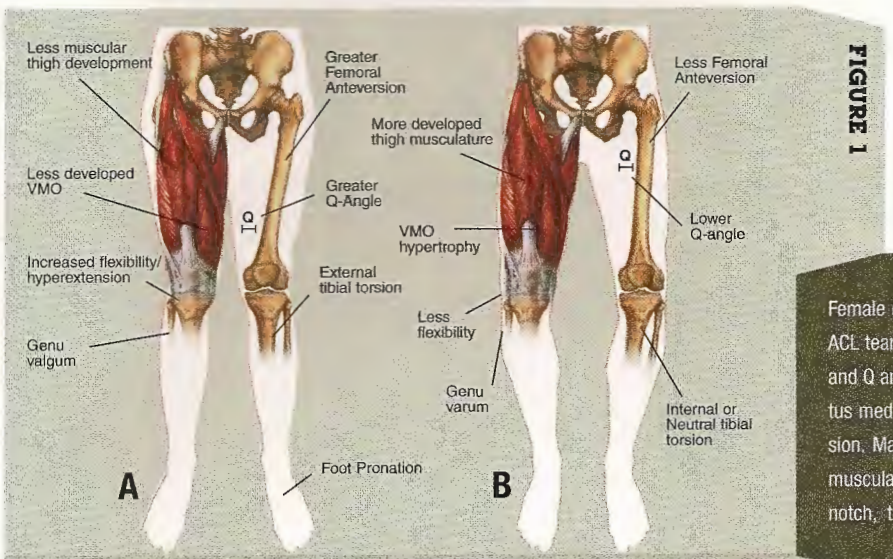
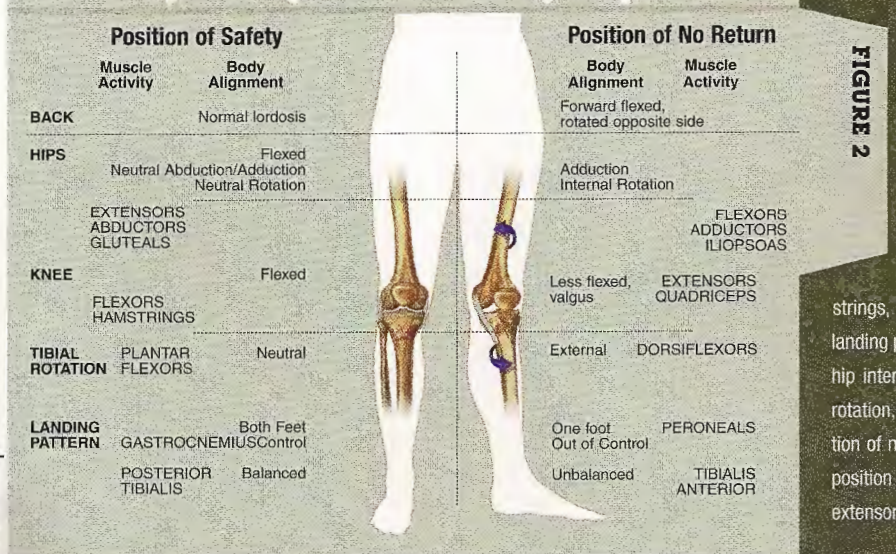
FIGURE 1



Female (A) and male (B) lower extremity alignment may predispose the female to ACL tears and patellofemoral disorders. Females have greater femoral anteversion and Q angle, increased flexibility, less developed musculature, less developed vastus medialis obliquus, narrow femoral notch, genu valgum, and external tibial torsion. Males have a less femoral anteversion and Q angle, more developed thigh musculature, vastus medialis obliquus hypertrophy, less flexibility, wider femoral notch, tendency toward a genu varum, and internal or neutral tibial torsion. (Adapted and reprinted with permission from: Fu FH, Stone DA (eds) Sports Injuries: Mechanism, prevention, and treatment, 2nd ed. Baltimore: Williams & Wilkins, 1994, p154.)

FIGURE 2



Muscle activity and body alignment in the position of safety is compared to position of no return. In the safety position of landing, the trunk and pelvis are in neutral, hips and knees are flexed, tibia internally rotated, foot supinated. In this safety position, muscle activity which are protective at the hip are extensors, abductors, gluteals, knee flexors or hamstrings, and calf planter flexion, gastrocnemius, posterior tibialis. In the high risk landing position, the pelvis is anteriorly rotated, which creates lumbar hyperlordosis, hip internal rotation, adduction, and varus, knee hyperextension is under internal rotation, torque, in valgus, with tibial external rotated and foot prorated. In the position of no return, muscle activities which are proposed to be active based on joint position and review of injury videotapes are hip flexors, adduction, iliopsoas, knee extensors, quadriceps, and calf dorsiflexors, peroneals and tibialis anterior.