Grant Information Summary:

The Effects of Hormone Levels in Female Athletes on the Frequency of Anterior Cruciate Ligament Injury

Practical Significance:

Anterior Cruciate Ligament (ACL) injuries occur more commonly during the late luteal and early follicular phases of the menstrual cycle.

Background

Females injure their ACLs more frequently than males participating in similar athletic activities. The cause for this is likely multifactorial. One possible explanation for this is gender-specific differences in ligament remodeling. Tissue remodeling occurs by a continuous cycle of protein synthesis and degradation. Steroid hormones regulate expression of some of these proteins. We hypothesize that the type of hormone, or the nature of exposure to it, could affect the remodeling capabilities of the ACL, and thereby alter its mechanical properties. A key component to the hypothesis is identifying a period of time during the menstrual cycle where a disproportionate number of ACL injury occurs. Several studies have implicated different cycle phases for increased incidence of ACL injury. However, all the studies are limited by relying on athlete histories provided to the medical staff as to when the injuries occurred relative to the menstrual cycle.

Objective

The purpose of this study is to determine if ACL injury occurs randomly or is clustered around a specific phase of the menstrual cycle, and to confirm the injury date and menstrual history by salivary estrogen and progesterone measurements.

Subjects

A total of 37 female athletes (20 college and 15 high school and 2 recreational athletes) were evaluated at the time of ACL injury, over a three year period.

Measurements

A questionnaire was filled out and physical exam, MRI or surgery confirmed ACL injury. Saliva samples were obtained from 37 athletes within 48 hours of injury and 32 were analyzed for hormone levels. Six saliva samples did not have enough volume to be tested. Thirteen additional control samples from non-injured females were obtained to test the correlation between salivary and serum sex hormone levels. Progesterone was assayed by routine radioimmunoassay. Estradiol was assayed utilizing a modification of the Diagnostic System Laboratories 3rd Generation Double Antibody Estradiol assay in the laboratory of Dr. Dave Hess at the Oregon Primate Center.

Results

The correlations between saliva and serum estrogen and progesterone were (.73) and (.72) respectively. Twenty-six of 37 athletes injured their ACLs during the follicular phase of the menstrual cycle (Table 1) and (Graph 1). Interestingly, we found that 10 of the 27 injuries occurred in the few days preceding and first two days following the onset of menses (Graph 1). Difference in the frequency of observed injury for days 1-2 of the menstrual cycle was found to be significant at a=0.05.

Conclusions

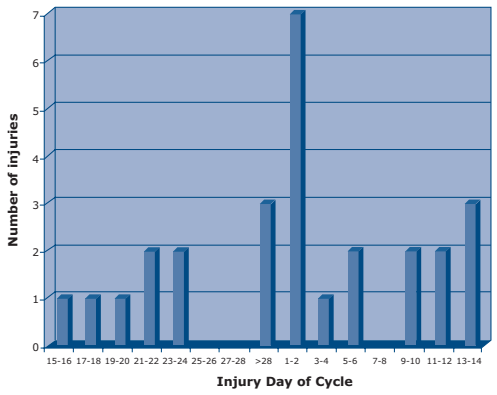
ACL injuries occur more commonly during the late luteal and early follicular phases of the menstrual cycle.
Salivary sex hormone levels correlated with the reported cycle day.

Table 1: Number of Athletes Injured by Menstrual Phase

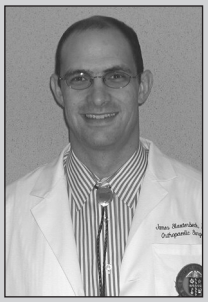
Injury day	Follicular phase				Luteal phase				Total
	ef	mf	lf	t	el	ml	Ll	t	
Cycle day reported	10	6	0	16	4	3	3	10	27
Cycle day not reported	4	1	5	10	0	0	1	1	10
All data	14	7	5	26	4	3	4	11	37

ef: early follicular, mf: mid follicular, lf: late follicular, el: early luteal, ml: mid luteal, ll: late luteal; t: total

Graph 1: Cycle day vs. injury



Principal Investigator:



James Slauterbeck, MD

Texas Tech Medical Center
Phone: (806) 743-2465
ortjrs@ttuhc.edu

Publication & Presentation List

NATA Annual Meeting,
Los Angeles, CA, June 19-23, 2001

NIH Grant: Molecular Basis of Gender Differences in ACL Injuries Submitted 03.01.01

Molecular Basis for ACL Injury in Female Athletes. Los Angeles, CA 2001

2952 Stemmons • Dallas, TX 75247
214-637-6282

The mission of the NATA Research and Education Foundation is to enhance the healthcare of the physically active through funding and support of research and education.