



Grant Information Summary:

Estrogen Concentrations Across The Menstrual Cycle Are Not Significantly Related To Motoneuron Activity Or Knee Joint Laxity

Practical Implications:

Based on the data in this study, fluctuating concentrations of Estrogen in the female is not related to motoneuron activity or knee joint laxity.

Background

Despite extensive efforts to identify the mechanism or combination of mechanisms responsible for the high incidence of female non-contact ACL injuries, the exact etiology remains unknown. Factors such as anatomical differences between sexes, neuromuscular characteristics of the sexes, and hormonal influences in the menstruating female have all been studied. However, no studies have investigated a combination of hormone levels, neuromuscular characteristics, and knee joint laxity.

Objective

The purpose of this study was to determine if changes in estrogen concentrations over the course of the menstrual cycle were related to motoneuron activity or knee joint laxity.

Design and Setting

Correlational design study conducted in the Sports Medicine Laboratory at Oregon State University.

Subjects

Twenty-eight female subjects (mean age = 22.4 ± 3.4 yrs) who reported regular menstrual cycles between 28 and 32 days in length with no more than 3 days of variation over the past 3 cycles participated in the study. Female volunteers were excluded if they reported the use of hormone-based birth control within the past year. Fifteen male subjects (mean age = 22.3 ± 3.7 yrs) served as the control group.

Measurements

Saliva samples, Hoffmann reflex

(H-reflex) measurements, and knee joint laxity values (Compu KT @ 133.5 N) were obtained each testing day. Female subjects were tested every other day, starting on the second day of their cycle; male subjects were tested every fourth day over 28 days. Hormone levels (ESTROGEN and PROGESTERONE) were measured using a 2 ml saliva sample collected via passive drool, then centrifuged and frozen at -70°C for later analysis. The ratio of the Maximum H-reflex to Maximum M-wave (Hmax/Mmax ratio) in the soleus muscle served as the H-reflex outcome measure.

Correlations of the outcome variables were calculated for each subject by pairing measurements made on the same day. One-sample t-tests were used separately for male and female data of each variable to evaluate whether the mean correlation differed from zero ($\alpha = 0.05$). In addition, two-sample t-tests were used to test the difference of the male and female correlations for each variable. Mean correlations and p values are presented in Table 1. The results

of the test of the difference of the correlations are presented in table 2.

Results

Results indicate no association between female hormone levels and motoneuron activity or knee joint laxity during the menstrual cycle. Significant correlations between H-max/M-max ratio and both progesterone and knee joint laxity in the male subjects. In addition, not only was the correlation between Hmax/Mmax ratio and laxity significant it was significantly different from the female group's correlation.

Conclusions

Based on the data in this study, fluctuating concentrations of Estrogen in the female is not related to motoneuron activity or knee joint laxity. Future research in the area of hormones must investigate how other mechanisms combine with hormonal factors to influence put females at a higher risk for ACL rupture.

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Table 1: Correlation Matrix

	Laxity	H-max/M-max	Estrogen	Progesterone	
Laxity	-	r=-0.04 p=0.46	r=0.04 p=0.62	r=0.10 p=0.14	Females
H-max/M-max	r=-0.31 p=0.01*	-	r=-0.01 p=0.86	r=-0.09 p=0.14	
Estrogen	r=-0.11 p=0.13	r=-0.03 p=0.89	-	n/a	
Progesterone	r=-0.17 p=0.26	r=-0.23 p=0.02*	n/a	-	
		Males			

Table 2: Test of the differences of the correlations between Males and Females

Correlation	probability
Laxity vs. Estrogen	p=0.13
Laxity vs. Progesterone	p=0.11
H-max/M-max ratio vs. Estrogen	p=0.93
H-max/M-max ratio vs. Progesterone	p=0.17
H-max/M-max ratio vs. Laxity	p=0.01*



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