

2005 S3: Stacy Makino

MUSCLE ACTIVATION DURING THERAPEUTIC EXERCISES OF THE SHOULDER

Purpose

To identify muscle-firing characteristics and there determine the exercises which target the supraspinatus (SUP), subscapularis (SUB), infraspinatus (INF) and teres major (MAJ).

Subjects

Fifteen college students between the ages of 20-22 reported to the Human Performance Laboratory for participation. Subjects must not have experienced a subluxation or dislocation episode, and currently have no pain in their dominant arm and shoulder.

Method

After completing the approved informed consent form demographic data was collected (Height, Weight, Age, Dominant arm). Subjects then were introduced to a series of rehabilitation exercises: 1 - 90/90 Internal Rotation (IR), 2 - 90/90 External Rotation (ER), 3 - Neutral (NEU) IR, 4 - NEU ER, 5 - Scaption (SCAP) IR, 6 - SCAP ER, 7 - Lat Pull, and 8 - Horizontal Abduction . Once they were comfortable with the exercises they were prepped for the insertion of the electrodes. After insertion subjects randomly completed each exercise. Electromyographic data was collected during each exercise.

Measurement

For each subject muscle activity was collected using electromyography. Data was first filtered using a Blackman -67 (20-100 MHz) bandpass filter and then rectified. Five repetitions (3-7) per exercise were used in analysis. The integral and delta s were extracted from each repetition

Results

A 2-way repeated measure ANOVA, $\alpha = 0.05$, was run to identified significance and followed with a Tukey HSD Post-hoc analysis. Significance in the interaction between the muscle and motion was identified. For the SUP, 90/90 ER elicited the most muscle recruitment. The INF and MAJ, were both recruited greater during 90/90 ER and SCAP ER exercises.

Discussion

Recruitment during 90/90 ER, and SCAP ER was significantly greater for the SUP, INF, and MAJ. With the 90/90 ER being slightly higher than the SCAP ER motion. Recruitment during 90/90 ER and SCAP ER was significantly greater than other motions for the MAJ, the authors feel that this may be due to decreases in ER strength and therefore substitution.

Conclusion

External rotation at 90/90 and in scaption elicit the most muscle recruitment for the SUP, INF, and MAJ and therefore should be staples in rehabilitation protocols for the Glenohumeral joint.

Mentor: Brian Hatzel

2005 S3: Matt Race

IMPROVING THE STATISTICAL CURRICULUM SEQUENCE

Most introductory statistics classes have been taught using a standard curriculum sequence. We developed a new statistical curriculum sequence with the goal of improving student learning and memory of statistical concepts. Our proposed curriculum sequence came about by essentially inverting the traditional sequence model. We will test our proposed curriculum sequence throughout the 2005-2006 school year in STA 215 (Introductory Applied Statistics) classes to determine if this improves learning. We will also be following these students in future statistics related classes (such as PSY 300 or SS 300) to determine if this improves memory as well.

Mentor: Dr. John Gabrosek

2005 S3: Maysee Salleva

ENVIRONMENTAL PHOSPHORUS ANALYSIS BY ^{31}P NMR

^{31}P -Phosphorus Nuclear Magnetic Resonance Spectroscopy (^{31}P NMR) was used to analyze biochemical and environmental samples. The pH dependency of the ^{31}P NMR chemical shifts indicated that all phosphate compounds displayed downfield chemical shifts in basic solutions. Lipo phosphate was found to be soluble only at low pH levels. It was confirmed that acidic solutions encouraged decomposition of polyphosphates via hydrolysis, whereas basic solutions did not. Experiments on mixed orthophosphate standards revealed that the number of known species in a mixture is not an indication of chemical shift, as there may be equilibration between the compounds. Environmental phosphorus samples provided by the AWRI were found to contain orthophosphate and pyrophosphate. Other assignments are indeterminate.

Mentor: John Bender

2005 S3: Nathan Siladke

WATER EVAPORATION IN TROPOSPHERIC AEROSOL

With the recent discovery of the ubiquity of organic material in tropospheric aerosols, it has been postulated that the rates of water evaporation and condensation into the aerosols could be affected by thin surfactant films, which could ultimately affect cloud formation. Nathanson et al. have begun to study the effect of water evaporation from sulfuric acid solutions through the short-chain surfactant, butanol. They have found that a nearly full monolayer of butanol fails to reduce water evaporation from the acid. This

unexpected result raises many questions about the mechanism of water evaporation. We propose the use of molecular modeling to help answer some of these questions as it allows us to examine the trajectory by which a molecule leaves the liquid at the molecular level. We also are able to study this problem under conditions closer to that of the troposphere because we are free of certain experimental limitations.

Mentor: Chris Lawrence

2005 S3: Brittany Stropich

PROTEIN INTERACTIONS IN DIAPHANOUS-RELATED FORMINS: DEFINING SPECIFIC BIOCHEMICAL INTERACTIONS INVOLVED IN THE REGULATION OF IMPORTANT CELLULAR PROCESSES

The cytoskeleton plays a crucial role in the maintenance of cell shape, cell movement, and cellular division. Our laboratory focuses on a conserved family of proteins, the Diaphanous-related formins (DRFs), that act as "molecular switches" in signaling to the cytoskeleton. Since the DRFs are an important focal point in many cellular processes, it is vital that these proteins are tightly regulated. Normally, DRFs exist in an inactive state ("closed") by an intramolecular interaction between the Diaphanous inhibitory domain (DID) and the Dia-autoregulatory domain (DAD). In response to external stimuli, DRFs are activated by Rho GTPases, which bind to the GTPase Binding Domain (GBD) and "open" the protein. Once activated, the DRF can send signals to other cellular pathways. Here, we have focused on the regulation of a specific DRF by probing the DID-DAD interactions and determining a potential phosphorylation site that may act as a mechanism to activate the DRF. Using a combination of site-directed mutagenesis and cell biology, we have generated mutations in the DID region that mimic a proposed constantly activated and inactivated state of the DRF. As a result, we have found a mutation that causes filopodia forming actin in cells. In order to determine if the mutations disrupt the DID-DAD binding, we have future plans to employ fluorescence anisotropy to calculate the affinity of purified GBD-DID protein constructs to fluorescein-labeled DAD peptides. Thus, we have the ability to be able to "link" the affinity of specific GBD-DID interactions with functional effects in the cell.

Mentor: Dr. Brad Wallar

2005 S3: Catherine Sundt

SOCIAL DIMENSIONS OF CONSUMPTION IN SANTIAGO, CHILE - SUMMER 2005

Using field notes and interviews collected in Santiago, Chile in the summer of 2003, Catherine and Dr. Stillerman are investigating the social aspects of interaction, retail,

and informal vending in several spaces throughout Santiago, including a flea market, a farmer's market, and a mall. They are also researching existing sociological theory regarding public space and the informal economy, and plan to publish an article in a sociological journal detailing their findings and making an original contribution to the field of sociology.

Mentor: Joel Stillerman

2005 S3: Timothy Trichler

THE ACUTE RESPONSES OF PULMONARY AND CORONARY ARTERIES TO NATURAL STEROIDS

The purpose of this study was to characterize the specific responses of coronary and pulmonary arteries to natural steroids. It is hypothesized that the responses will vary depending on the androgen and anatomical location of the artery. Porcine coronary and pulmonary arteries were isolated and subjected to increasing concentrations of dihydrotestosterone (DHT), testosterone (TES), androstenedione (ANDRO) and dehydroepiandrosterone (DHEA). High concentrations of TES and DHT caused a significant dilation in coronary and pulmonary arteries. The specific responses to TES and DHT were significantly different than the specific responses to ANDRO and DHEA in coronary arteries. There was no significant difference in the pulmonary arteries to the androgens. Coronary arteries exhibited greater relaxations to TES, DHT and ANDRO than pulmonary arteries. Pulmonary arteries exhibited greater relaxations to DHEA than coronary arteries. The results of these studies indicate that the androgens elicit an effect on arterial diameter, depending on the androgen and anatomical location of the artery.

Mentor: Frank Sylvester

2005 S3: Catherine Willis

STUDY OF THE HUMAN MITOCHONDRIAL DNA POLYMORPHISM.

The ancestral origin of human beings can be traced according to nucleotide sequence patterns of mitochondrial DNA (mtDNA) haplogroups. The haplogroup that a person may belong to is identified by locating particular single nucleotide polymorphisms (SNPs) that have been mapped out in the mtDNA. If a person has a certain combination of SNPs this will show that they belong to a specific haplogroup.

We are interested in finding the origins of groups of peoples and simplifying a process for screening the mtDNA haplogroups that have been used in the past to identify people's maternal origins. Using our modified method of identifying haplogroups we analyzed the mtDNA from a group of randomly selected people to test the modified

approach. Then the method was used on a blind study of people from southeastern Europe who have not been studied thoroughly. They could represent an isolated sub-population of Eastern Europe, and by closer analysis of their mtDNA it could possibly gain this population ethnic recognition as minority. The amplification of the human mtDNA samples was done by a polymerase chain reaction (PCR) where specific segments of the mtDNA from the human samples could then further be examined by restriction fragment length polymorphism (RFLP) analysis to identify the haplogroups of the people in the sample. During the course of this project multiplex PCR was used, which simplified the process that was used in recent studies. Another approach at simplifying the method of identifying mtDNA haplogroups was to run a PCR that contained the identifiable SNP in the PCR primer sequences. It was speculated that this would eliminate the need for RFLP analysis, because the samples that contained the SNP could be identified by looking at the PCR product on a gel electrophoresis. In the next steps of the project, the use of multiplex PCR and gradient PCR with modified primers will be analyzed more closely to further simplify the method of screening haplogroups.

Mentor: Dr. Alex Nikitin