Poster Session 2

Commons East, Easel 59

12:45 PM to 2:15 PM

Multiple Applications of Botulinum Neurotoxin and Masseter Muscle Activity in Rabbits

Michael Christopher (Michael) Gross, Senior, Biochemistry, Microbiology
Mentor: Zi-Jun (Zee) Liu, Orthodontics
Mentor: Susan Herring, Orthodontics
Mentor: Katherine Rafferty, Orthodontics

Botulinum neurotoxin type A (BoNT/A) has been extensively used in human masticatory muscles for cosmetic reduction of large masseter muscles, relaxing the muscles and reducing pain in temporomandibular joint and muscle disorders, and decreasing loading on the mandible. Multiple applications of BoNT/A over time is a clinically routine practice to reach the treatment goal. However, it is unknown how the muscle responds to multiple neuromuscular blockages by BoNT/A, and whether or not the injected muscle shows functional recovery differently after each application. This study was designed to answer these questions. Adult New Zealand rabbits were injected 3 times either with BoNT/A (n=13) or saline (n=5) in one masseter at week 0, 12, and 24. Non-invasive surface electromyography (EMG) of bilateral masseter muscles was recorded during natural mastication 1 week before the first injection and every two weeks thereafter up to week 35. Jaw movement was video-taped and synchronized with EMG recording for identifying the chewing side. Body weight was tracked weekly to examine the effect of BoNT/A on general health. From each of these recordings, 15-20 consecutive chewing cycles from each chewing side were sampled and analyzed for chewing cycle length, muscle mean and integral activity, and durations. The preliminary results indicate that the recovery patterns of the 11-12 weeks after each BoNT/A injection differed significantly, and both the chewing frequency and muscle activity 11 weeks after the 3rd injection (week 35) were close to those of saline animals and the baseline recorded before injection. These findings provide new information about the consequences of multiple applications of BoNT/A on masticatory muscles, and may lead to the better understanding and use of BoNT/A in clinical dentistry.

Session 2R

Evolving Systems in Biology: From Molecules to Marsupials

Session Moderator: Billie J. Swalla, Biology

022 JHN

3:45 PM to 5:15 PM

* Note: Titles in order of presentation.

Finite Element Analysis of Teeth and Alveolar Bone, Linking Mammal Chewing Patterns to the Form and Function of the Periodontal Ligament

Becca Anderson, Senior, Biology (Physiology)
Mentor: Susan Herring, Orthodontics
Mentor: Casey Self, Biology

Relatively little is known about the periodontal ligament (PDL), a fibrous collagen structure which anchors teeth to the jaws and is thought to be a key factor in redistributing stress from teeth during mastication. However, to date the nature of this redistribution has not been established, hampering efforts to understand how best to regenerate a PDL that has been damaged. The goal of this project was to determine whether chewing patterns in mammals are correlated with the arrangement and direction of collagen fibers in the periodontal ligament. Specifically, I hypothesized that carnivorans, which chew in an up-down motion with high force, should maximize fiber number. In order to do this, fibers should be arranged radially at an average angle of 90 to the root. Stress should be greatest at the apex of the root. I embedded and sectioned mandible (lower jaw) samples from American mink (*Mustela vison*) into 7-micrometer slices, and examined the stained slides under a microscope to determine fiber angles. Samples were sliced in both horizontal and coronal planes. To assess stress, I created a finite element analysis (FEA) model of a single-rooted tooth using MSC Patran and Nastran, to which I can apply loads in various strengths and directions to simulate the response of the PDL under many different conditions. Due to lack of studies on the PDL in general, this is an isotropic model using material properties from the literature. Although this model is based on idealized geometry it should still show the correlation between stress and fiber angle for a given chewing direction. Preliminary results confirm the expectation of 90 fibers in carnivorans (86 ± 5). These data can now be incorporated into the FEA model. Future work will examine mammals with different chewing directions, such as rabbit (sideways motion) and mouse (forward motion).