A109 Long-Term Cocaine Use and Its Potential Effect on Bone Morphology

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After attending this presentation, attendees will understand that long-term cocaine use has effects on bone morphology at the macroscopic and microscopic level.

This presentation will impact the forensic science community by demonstrating that the effect of drugs on bone morphology is an area of study that should be expanded. With the findings of this study, it is apparent that cocaine use and substance abuse can potentially cause age-at-death estimation to be inaccurate. Other works and clinical analyses have proven other drugs to alter bone, but no research has examined the effect of cocaine on bone morphology.

The purpose of this study was to assess the bones of rats exposed to long-term *ad libitum* consumption of cocaine for physical evidence of cocaine use. While it is accepted that many drugs, both prescription and drugs of abuse, do have powerful metabolic effects, those changes have not been examined at the microscopic level.

Eleven male Wistar Rats (*Rattus norvegicus*) from the Laboratory of Behavioral Neuroscience at Boston University in Boston, MA, comprised the experimental group. The rats self-administered cocaine over four weeks at a 0.3mg/kg dosage and the concentration of the IV solution was 1.6mg/ml of cocaine. The control group included five female Sprague Dawley rats (*Rattus norvegicus*) from the Boston University Animal Science Center in Boston, MA. The specimens were exposed to a training protocol but were not given any drugs. All rats went through a dissection and maceration to obtain the femora and humeri. Mass, volume, and length measurements were taken for each element to be used for later analysis. One femur was chosen at random from each rodent to be used for histological analysis. Femora were embedded in a two-part epoxy resin, then cut in half using a diamond band saw. A Buehler® IsoMet™ low-speed saw was used to obtain thinner sections and a Buehler® MetaServ™ 250 grinder was used to achieve a thickness of 100µm-120µm. India ink was used for staining and all stained sections were put onto slides, covered with Permount™ and a cover slip, and labeled.

The outer circumferential lamellar layer of bone diaphyses were measured and compared between the experimental and control groups. Photographs were taken of each cross-section at 1x and 4x magnification through the NIS-Elements™ software. The ImageJ image-processing program was used for analysis. The thickness of the outer circumferential lamellar and the thickness of the total cross section was taken at four random locations of each 4x magnification photograph. The ratio of the thicknesses and the outer circumferential lamellar thickness alone were compared.

A significant difference was found between the density values calculated from the original mass and volume measurements between control and experimental groups. Samples that had been exposed to cocaine had lower density values than those not exposed to any drugs. The control group mean density equaled 1.492g/mL and the experimental group mean density equaled 1.082g/mL. A significant difference was also found between the ratio of the thicknesses and between the outer circumferential lamellar thickness alone. The experimental group had ratio values significantly higher than the control group. The control group's mean ratio equaled 0.2686, while the experimental group's mean ratio equaled 0.4427. This indicates that in the control group, the outer circumferential lamellar thickness, on average, covered approximately 25% of the total cross section, and the experimental groups outer circumferential lamellar thickness, on average, covered nearly 50% of the total cross section. These results were similar when comparing the outer circumferential lamellar thickness alone. The control group's thickness was significantly lower than the experimental group's thickness. The control group's thickness measurements had a mean of 189.7674µm and the experimental group's thickness measurements had a mean of 343.2753µm.

The data reveal that long-term exposure to cocaine has a detectable effect on bone morphology. Further exploration of this phenomenon may show that the changes in bone morphology may be diagnostic for drug abuse. That information could be of use in a medicolegal setting and may alter the accuracy of age-at-death estimations.

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