Metal elements deposition in Bones
Understanding the metals environmental exposures through human skeletal system deposition constructing a surrogate measure for exposure
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Introduction
Skeletal bones have long been considered and widely used as a valuable biological matrix to measure metal elements to evaluate environmental metals exposure to the individual and the population. Bone tissue analysis represents a precious tool for both forensic sciences and paleopathology. It has allowed medical sciences to decipher the mysteries surrounding the history of the evolution of mankind.
We describe the application of this method for the biological monitoring of a first responder exposed to the extremely toxic environment during the rescue and recovery operations after the collapse of the World Trade Center twin towers in 9/11/2001 after the terrorist attack in New York City.

Material and Methods
In 2016, we collected a vertebral bone sample of a former world trade center responder to assess a bone lesion showing systemic sarcoidosis involving the lumbar vertebra. We proceeded with the tissue metal elements measurements in the vertebral bone. The measurement was performed with the laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). We used a 193 nm ArF NWR laser and an Agilent 8800 ICP-MS which allowed us to measure Iron, Calcium, Chromium, Copper, Sulfur, Manganese and Barium.

Results
We are able to compare the concentrations of the elemental metal found in our patient with the published reference values for the bone tissues, available since 1999 from the international agency for Atomic Energy.

Discussion and Conclusion
We have noticed that all but one bone metals measured in our patient were within the reference values available from the literature. Barium levels were higher than expected at 12-14 ppm (reference values 2.7-6 ppm 5-95 percentiles).
After comparing the bone analysis result with the data regarding acute environmental exposure, we have hypothesized that elevated bone barium is the result of the acute exposure to the concrete and building material dust occurred after 9/11. It is plausible that barium, being a bone seeker with extremely high affinity for bone tissue, is the last measurable bone metal in our patient’s vertebrae, 16 years after the 9/11 tragedy. It is elevated probably due to its extremely slow clearance from the skeletal system.

References