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Reliable Genetic Identification of Burned Human Remains

The reliable genetic identification of burned human remains can be a very difficult process. Two problems that forensic anthropologists frequently come across when working with burned human remains are that either there's no DNA available or the DNA is contaminated with foreign DNA. Foreign DNA can come from melted plastic or textiles that have become infused into the bone and the bones are usually too fragile to handle let alone scrape. Burns can be classified into five different groups; well preserved, semi burned, black-burned, black-grey burned, and blue-grey-white burned. Often the DNA profile is not in CODIS (Combined DNA Index System), and the result will be a complete profile but the name will be listed as a Jane Doe or John Doe. Most DNA profiles in CODIS give at least general information, like the nationality and sex of the sample. One way to get DNA results is to do a Real-time PCR test, and then do an Electropherogram on the amplified sample of DNA.

Forensic anthropologists can tell a lot about a person just by looking at their bones. Gender can be determined by looking at the pelvic bone or the sciatic notch if the pelvic bone is missing (Jefferson 2003). The skull can also be a very important determinate of gender due to the hormonal development of the person. Males produce the hormone called testosterone, which affects bone development causing males to have bigger joints and more well defined muscle attachment sites on their bones. Adult males tend to have larger jaw bones that are squarer in

shape than women; they also tend to have more prominent brow bones. Most women have a smaller jaw bone that comes to a single point at the front and a smoother forehead (Murray 2013). Age can be determined by looking at the growth plates of that individual. The texture of the pelvic bone can often be the best way to pin down an age estimate, however trying to touch and handle the burned bones of a victim can be very difficult.

When bones are burned, the heat from the fire causes water to leave the bone which dehydrates it and destroys the collagen structure of the bone (Hanson 2006). The fire can also greatly distort or alter bones' shape. Bones that are more shielded from the fire due to the soft tissue surrounding them are less likely to show alterations from the fire (Steven A. Symes 2012). "Green Bone," or bone with the flesh still on the bone, tends to warp when it burns, and its transverse fractures curve or even spiral rather than encircling the shaft (Jefferson 2003). The pores in other bones become enlarged and between each pore is a thin brittle piece of bone that, with the slightest pressure can cause the bone to shatter. Also, in most cases when a body is discovered in a fire, foreign objects such as melted plastic or textiles are infused with the bone making it very difficult to examine the bones thoroughly. The other problem with bodies in fires is that sometimes the DNA is non-existent, or foreign DNA is present which makes the determination of identification sometimes impossible.

There are five different categories of burns a body can be classified into. Well preserved is where the body is just barely burned and blisters are visible and most of the skin has been burned off, but identification is still possible. Semi-burned is where the body is slightly charred and some bone can be seen and most of the skin is black in color. The tissue is still in good shape so identification is possible. Black-burned is where the body is completely black in color and the

muscle has been completely burned away from the bone mostly in the legs and arms and head. Tissue still remains on the torso, so positive identification can be established. The black-grey burned classification is where the body's muscle tissue has been burned off from 90% of the body and the bones are black and brittle. No tissue is left so positive identification is very difficult to establish. With blue-grey-white burned bodies, the remains have been so badly burned that just like the victims of the bombing of Hiroshima that were basically a pile of ashes frozen in the shape of the victim, if touched, the ashes would crumble and the body would be unrecognizable. Positive identification is impossible to do, because all bones in the body have been broken down and reduced to ashes (Schwark 2010).

Burning a body is not like burning a piece of paper or wood. When a body is cremated the furnaces are set to between 1100 to 1500 degrees Fahrenheit and still not all of the bone is destroyed. People have to sift through the ashes and grab the bones that escaped the heat and grind them up and add them to the ashes again. It is next to impossible to completely destroy human bone due to its crystalline structure (Hanson 2006).

If a DNA sample can be obtained then it can be run through CODIS. CODIS is like a gigantic database and electronic search engine that allows every laboratory in the United States to share DNA information about suspects, criminals, and victims of crimes. A match may be found and then the investigators know exactly who that person is. Sometimes the results from CODIS can only be a partial match due to the fact that the CODIS database only has an incomplete profile on the person, or the DNA was so disintegrated from the fire that some of the sequence was missing. This can be a very common problem when dealing with burned victims due to the fact that the fire degraded the body so bad that a tissue sample was unable to be

obtained and the bones were so badly degraded that no DNA could be collected from that source either. Dental records can be very useful when this happens but what if the killer planned ahead for this and pulled out the victims teeth? Then what are the investigators supposed to use? This was the exact case in the death of Patty Rogers, a 27 year-old Tennessee housewife. Her husband, Matt Rogers, killed her after finding out that she was going to leave him for her best friend's brother. He then surgically removed the front of her skull, and disposed of it in a dump outside of town. He let the body decompose in the trunk of his car in the summer heat, with temperatures inside the trunk of his dark colored car reaching well above 100 degrees Fahrenheit for the better part of the day. He then burned her body on the mattress where she had been shot in the head, and moved her remains into a steel barrel to finish the burning process. The investigator sent off a sample from a vertebral fragment, which had fallen off her body and landed at the bottom of the barrel escaping most of the damaging heat from the fire, to a private forensic lab which when tested yielded enough DNA to reverse compare to samples from her parents. Matt Rogers was convicted of second-degree murder and was sentenced to twenty-five years in prison (Jefferson 2003).

What process did the private forensic lab use to get the DNA from the bone fragment? They used a process called Real-time Polymerase Chain Reaction, or Real-time PCR. A machine is used to amplify and simultaneously quantify a targeted DNA molecule. It enables both detection and measurement of one or more specific sequences in a DNA sample. The scientists start off by taking the sample DNA that they want to quantify and adding it to a special PCR tube, then they add in different ingredients. Primer one is added which adheres to the first segment of DNA to be quantified. Primer two is then added which adheres to the other end of the

sequence. Nucleotides are added next and these provide the A's (adenine), C's (cytosine), G's (guanine), and T's (thymine) of the DNA code. These genetic building blocks help make copies of the sequence that is wanted. Lastly, the DNA polymerase enzyme is added, which acts like a little machine that reads the DNA sequence, and then attaches the matching nucleotides to create DNA copies. The tube is then placed into the machine which goes through a series of heating and cooling cycles. When the machine is done, there are over 1 billion copies of the DNA sequence. After this, scientists can run an electropherogram which is the record of raw data that is produced during DNA sequencing. An electropherogram displays the fluorescence produced by the DNA molecules that have been electrophoretically separated during the DNA sequencing process. The graph separates the sequence into base pairs, and then assigns each base a color. The results are then printed out onto a big piece of paper, so as the DNA gets larger by one base pair, a peak at each point on the x-axis is seen, the x-axis being the fragment size of the peak with the larger sized base pairs to the right side of the graph.

In an experiment, scientists used bones from different parts of the body and burned them to the different classifications. They extracted what DNA they could and ran the samples through the Real-time PCR, and then did an electropherogram on them. They looked at the data and compared it to the original or the control DNA sequence. They found that with the well-preserved burned sample they were able to detect 14-15 short tandem repeats (STR) locations or loci. The semi-burned sample they detected 10-13 STR loci. The black-burned samples they detected 6-9 STR loci. In the black-grey burned samples 3-5 STR loci were detected and the blue-grey-white burned samples only yielded 0-3 STR loci.

The results show that the identification via DNA analysis is reliable and reproducibility is possible from well-preserved and semi-burned bones. In black burned bones the DNA was highly degraded and in some cases no nuclear DNA was left, leaving mitochondrial DNA analysis as an option. Blue-grey burned bones lead only sporadically to authentic profiles, and the investigation of blue-grey-white burned bones barely led to any reliable results at all (Schwark 2010). The genetic identification of burned human remains is possible if the level of burns is within a certain range. If it is above that range then the DNA is too degraded to do a proper analysis and identification is not probable.

Works Cited

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