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Y-chromosome DNA extraction from post-cranial skeletal elements

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Y-Chromosome DNA Extraction from Post-Cranial Skeletal Elements

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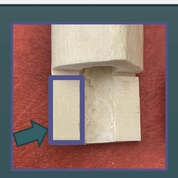
Introduction

- DNA has become an integral part of modern forensic science over the last few decades especially for use in identifying unknown deceased individuals
- The 2021 annual statistics report by NCIC, reported over 8,100 deceased individuals have been reported, an increase of over 100 individuals from 2020
- DNA extraction methods are known for bone tissue but where is best to take samples from is not
- The use of Y-chromosome DNA has shown very helpful in forensic science
- Can be used when autosomal DNA analysis fails to provide conclusive results and provides the biological sex

Project Goals

1. The main goal of this research was to analyze the yield of Y-chromosome DNA in samples of cortical and trabecular bone to determine there is a potential difference in the how each preserves
2. A secondary goal of this project that was to show how successful DNA analyses can be done without causing excessive damage to the bones while collecting samples.



Cortical Bone

Trabecular Bone

Hypothesis

- Due to the structure of trabecular bone, samples taken throughout the remains that contain only the trabecular bone will yield higher amounts of Y-Chromosome DNA molecules in comparison to samples taken from the compact bone.

Materials and Methods

Skeletal remains donated to the UM forensic anthropology department through body donation facilitated by the Montana State Crime Lab

- 80 total samples from 40 different testing locations across the remains were analyzed
- Two samples were taken from each location: one cortical, one trabecular, making 39 of each, and two samples were collected from the petrous portion of the temporal bone
- Approximately 0.08-0.10g of bone was collected for each sample before being extracted and analyzed using qPCR

Results

- The results from the qPCR indicate that the hypothesis was not supported by the data
- The cortical bone samples produced higher yields of DNA across the board
- The data indicates that the cortical bone sample from Inter-condylar fossa of the distal right femur provided the best yield for both Y-chromosome and autosomal DNA
- The worst yield is from the inter-condylar fossa of the right femur having no Y-chromosome yield, and a very small yield of autosomal DNA
- Each sample was weighed before being extracted and analysis of the pre-extraction weight compared to the DNA yield showed a weak correlation.

Pre-Extraction Weight Correlation to Yield		
Y-chromosome	0.455	Weak Correlation
Autosomal	0.393	Weak Correlation

Cortical vs. Trabecular Averages (ng/µl)		
Y	Cortical Average	0.09890
Y	Trabecular Average	0.02130
Auto	Cortical Average	0.28260
Auto	Trabecular Average	0.10484

Side	Bone	Location	Type	Y-Average	Auto Average
Right	Femur	Inter Condylar Fossa	Cortical	0.59377	1.53072
Right	Tibia	Mid-Diaphysis	Cortical	0.43065	0.98559
Right	Tibia	Tibial Plateau	Cortical	0.33054	1.41029
Right	Femur	Nutrient Foramen	Cortical	0.30707	0.60443
Right	Clavicle	Lateral End	Cortical	0.27307	0.64781
Midline	C. Vertebrae	Vertebral Body/Dens	Cortical	0.20719	0.65028
Right	Scapula	Glenoid Fossa	Cortical	0.18945	0.73983
Midline	L. Vertebrae	Vertebral Body	Cortical	0.18860	0.54553
Left	Femur	Inter Condylar Fossa	Cortical	0.16343	0.47739
Left	Radius	Radial Tuberosity	Trabecular	0.14771	0.64271

Conclusion

- This research has produced preliminary data that can be used to improve future methods of sampling DNA from bone
- It gave insights on different factors that could have affected the results of this research as well as other studies in the future
- Further research is needed to increase the validity of the results

Future Directions

CODIS

Forensic Genetic Genealogy

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References

"2020 NCIC Missing Person and Unidentified Person Statistics." 2020. File. Federal Bureau of Investigation. 2020. https://www.fbi.gov/file-repository/2020-ncic-missing-person-and-unidentified-person-statistics.pdf/view.

"2021 NCIC Missing Person and Unidentified Person Statistics." n.d. File. Federal Bureau of Investigation. Accessed April 6, 2022. https://www.fbi.gov/file-repository/2021-ncic-missing-person-and-unidentified-person-statistics.pdf/view.

Kayser, Manfred. 2017. "Forensic Use of Y-Chromosome DNA: A General Overview." Hum Genet, 15.

Klevens, Adam, Dana D. Kollmann, Kelly M. Elkins, and Cynthia B. Zeller. 2020. "Comparison of DNA Yield and STR Profiles from the Diaphysis, Mid-Diaphysis, and Metaphysis Regions of Femur and Tibia Long Bones." Journal of Forensic Sciences 66 (3): 1104–13. https://doi.org/10.1111/1556-4029.14707.

Rodriguez, Ashley L., Hope M. Smiley-McDonald, M. Stirling Cummings, Sean Wire, Donia Slack, Christopher L. Williams, Kelly A. Keyes, and Jeri D. Ropero-Miller. 2022. "Understanding Unidentified Human Remains Investigations through the United States Census Data." Forensic Science International: Synergy 4 (January): 100225. https://doi.org/10.1016/j.fsisyn.2022.100225.

Siegert, Sabine, Lutz Roewer, and Michael Nothnagel. 2015. "Shannon's Equivocation for Forensic Y-STR Marker Selection." Forensic Science International. Genetics 16 (May): 216–25. https://doi.org/10.1016/j.fsigen.2015.02.001.