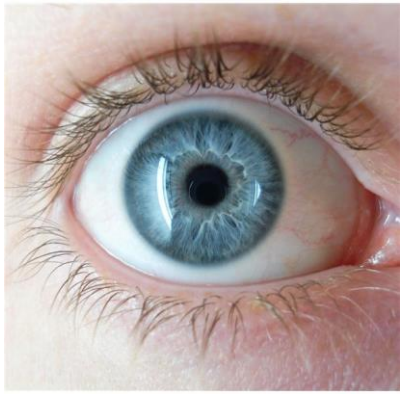
DNA conservation within Bone Tissue : prediction of human eye and hair color from skeletal remains



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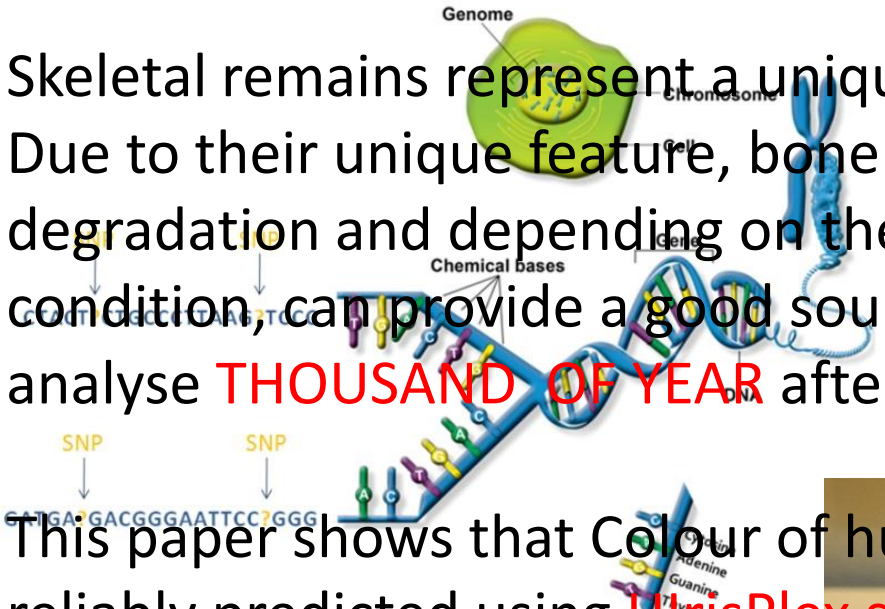
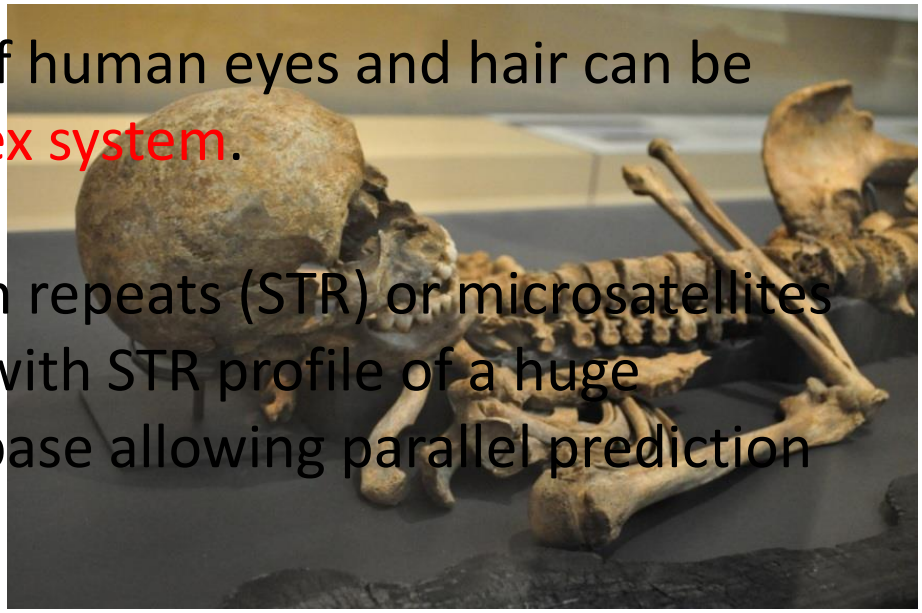
DNA within bone



Skeletal remains represent a unique type of biological material. Due to their unique feature, bone and teeth can be resistant to degradation and depending on the environmental storage condition, can provide a good source of DNA suitable for analyse THOUSAND OF YEAR after an organism death.

This paper shows that Colour of human eyes and hair can be reliably predicted using HIrisPlex system.



Analysis concerns short tandem repeats (STR) or microsatellites for direct match identification with STR profile of a huge genotype and phenotype database allowing parallel prediction of eyes and hair color.

Method

- Sample collection
  - ✓ They analysed 26 specimens (21 teeth and 5 bones) classified S1 to S26
  - ✓ S1 to S3 were contemporary human remains collected 2 years after death.
  - ✓ S11 was the teeth of an army general (Wladislaw Sikorski dead in 1943) at 69 yrs.
  - ✓ S24 was the teeth of a woman that lived in the 14th century.
- Precautions are taken to avoid contamination
- DNA was isolated using a standard organic extraction protocol

  15% bleach -> 70% ethanol -> drying -> UV irradiation -> -> -> 3g of bone powder for 1.5g of teeth -> incubation -> -> -> final volume of 70µl submitted to PCR to duplicate the DNA.
- The analysis is performed using a database of thousands of Europeans and a convenient Microsoft Excel macro.

Results

Table 1 HIrisPlex genotyping results together with sample age and starting DNA amount for the 26 samples tested

Sample ID	Sample/postmortem age	Starting template DNA (ng)	Genotype																							
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
S1	T/CR	0.6	C	G	C	C	G/T	C	C	G	C	G	T	A	G	A	C/A	C/T	G	G	A	C/T	T	T	C	G/T
S2	T/CR	1.7	C	G	C/T	C	G	C	C	G	C	G	T	A	G	A	C/A	C	G	G	A	C/T	T	T	C/T	G/T
S3	T/CR	1.2	C	G	C/T	C	G	C	C	G	C	G	T	A	G	G/A	C/A	C/T	G/T	G	G	C/T	T	G	C/T	G/T
S4	T/C	0.3	-	G	C	C/T	G	C	C	G	C	G	T	A	G	A	C/A	C	G/T	G	A	C	T	G/T	C	T
S5	B/C	U[a]	C	G	C	C	G	C	C	G	C	G	T	C	C	A	C/A	C/T	G/T	G	A	C	T	T	C	G
S6	B/C	0.3	C	G	C	C	G	C	C	G	C	G	T	A	G	A	C	C	G/T	G	A	T	T	G/T	C	T
S7	B/C	0.15	-	G	C	C	G	C	C	G	C	G	T	C	C	A	C/A	C/T	G/T	G	A	C	T	T	C	G
S8	B/C	U	C	G	C	C	G	C	C	G	C	G	T	C/A	G/C	A	C/A	C	G	G	A	C/T	T	G	C	G/T
S9	B/C	0.5	C	G	C	C	G	C	C	G	C	G	T	C/A	G/C	A	C/A	C/T	G	G	A	C	T	T	C/T	G/T
S10	B/C	0.1	C	G	C	C	G	C	C	G	C	G	T	C/A	G/C	A	C	C	G	G	G/A	T	T	G/T	C/T	G/T
S11	T/2WW	0.6	C	G	C	C/T	G	C	C	G	C	G	T	A	G	A	A	C	G/T	G	A	C	T	T	C	T
S12	T/2WW	2	C	G	C	C/T	G	C	C	G	C	G	C/T	A	G	A	C	C	G	G	A	C	T	G/T	C/T	G/T
S13	T/2WW	0.3	C	G	C	C/T	G	C	C	G	C	G	T	A	G	A	A	C	G	G	A	C/T	T	T	C	G
S14	T/2WW	0.2	C	G	C	C	G	C	C	G	C	G	T	A	G	A	C/A	C	T	G	G/A	C	T	G	C/T	T
S15	T/2WW	1.2	C	G	C	C	G	C	C	G	C	G	T	A	G	A	A	C	G/T	G	G/A	C	T	G	C	G
S16	T/2WW	0.1	C	G	C	C	G	C	C	G	C	G	T	A	G	A	C/A	C	G	G	A	C	T	T	C	T
S17	T/2WW	0.8	C	G	C	C	G	C	C	G	C	G	T	A	G	A	C/A	C	G	G	A	C/T	T	G/T	C/T	G/T
S18	T/2WW	2.8	C	G	C	C/T	G	C	C	G	C	G	T	A	G	A	C/A	C	G/T	G	A	C	C/T	G/T	C/T	G/T
S19	T/2WW	0.8	C	G	C	C	G	C	C	G	C	G	T	A	G	A	A	C	G	G	A	C	T	T	C	T
S20	T/2WW	0.4	C	G	C	C	G	C	C	G	C	G	T	A	G	G/A	C	C	G/T	G	A	C/T	T	G/T	C/T	G/T
S21	T/2WW	0.3	C	G	C	C	G	C	C	G	C	G	T	A	G	A	C/A	C	G	G	A	C	T	G/T	C/T	T
S22	T/2WW	0.7	C	G	C	C	G	C	C	G	C	G	T	A	G	G	A	C	G	G	G	C	C/T	G	C	T
S23	T/2WW	1.3	C	G	C	C	G	C	C	G	C	G	T	A	G	A	C/A	C	G/T	G	A	C/T	T	G/T	C	T
S24	T/XII	0.03[b]	C	G	C	C	G	C	C	G	C	G/A	T	A	G	A	C/A	C	G	G	A	C/T	T	G/T	T	G/T
S25	T/XIV	0.01[b]	-	G	C	C	-	C	T	G	C	-	T	A	G	A	C/A	C	T	G	G	C	T	G	C/T	G/T
S26	T/XIV	0.16	C	G	C	C	G	C	C	G	C	G/A	T	A	G	A	C/A	C	T	G	A	C	T	G/T	C	G/T

Results

Table 2 HIrisPlex-based eye and hair colour prediction results for the 26 samples tested

Sample	Probability values of hair colour categories	Probability values of hair colour shade	Inferred most likely hair colour	Accuracy probability value of predicted hair colour based on a >300 European test set	Probability values of eye colour categories	Inferred most likely eye colour	Accuracy probability value of predicted eye colour based on a >3800 European test set
S1	Brown 0.367	Light 0.268	Dark Brown	78.5%	Blue 0.317	Brown	87.5%
	Red 0.002	Dark 0.732			Int. 0.193		
	Black 0.499				Brown 0.490		
	Blond 0.133						
S2	Brown 0.246	Light 0.655	Dark Blond/Brown	78.5%	Blue 0.306	Brown	91%
	Red 0.001	Dark 0.345			Int. 0.142		
	Black 0.326				Brown 0.552		
	Blond 0.427						
S3	Brown 0.496	Light 0.215	Dark Brown	78.5%	Blue 0.190	Brown	90.4%
	Red 0.001	Dark 0.785			Int. 0.271		
	Black 0.406				Brown 0.539		
	Blond 0.098						
S4	Brown 0.064	Light 0.976	Light Blond	69.5%	Blue 0.919	Blue	97.4%
	Red 0.048	Dark 0.024			Int. 0.048		
	Black 0.025				Brown 0.033		
	Blond 0.864						
S5	Brown 0.251	Light 0.020	Black/Dark Brown	87.5%	Blue 0.706	Blue	94%
	Red 0.000	Dark 0.980			Int. 0.117		
	Black 0.729				Brown 0.177		
	Blond 0.020						
S6	Brown 0.227	Light 0.171	Dark Brown	78.5%	Blue 0.002	Brown	99%
	Red 0.000	Dark 0.829			Int. 0.026		
	Black 0.636				Brown 0.972		
	Blond 0.136						
S7	Brown 0.282	Light 0.030	Black/Dark Brown	87.5%	Blue 0.706	Blue	94%
	Red 0.000	Dark 0.970			Int. 0.117		
	Black 0.690				Brown 0.177		
	Blond 0.028						
S8	Brown 0.246	Light 0.196	Dark Brown	78.5%	Blue 0.024	Brown	95.6%
	Red 0.000	Dark 0.804			Int. 0.083		
	Black 0.594				Brown 0.892		
	Blond 0.160						

Discussion and criticism

- A number of cases remain unsolved because of no match between the STR profile and the reference DNA profil database, low amount of DNA and very often heavy degradation.

- The fact that (Wladislaw Sikorski) had blue eyes and blond hair as predicted via HIrisPlex was obtained from historical scripts.

- The sequence is too short (that cannot expression a protein, not at all) If it’s true as it seems to be, that means that difference between black eye and blue eye is completely insignificant, however crucial

Conclusion

- It can be anticipated that DNA prediction will soon because widely used in genetic studies of human remains.

- The recently introduced HIrisPlex system provides a convenient molecular tools for simultaneous prediction of eyes and hair colours categories from Bones remains's DNA.

- As demonstrated here, HIrisPlex system is significantly sensitive to enable successful analyse of bones and teeth of various ages

reference

Jolanta Draus-Barini, Susan Walsh, Ewelina Pośpiech, Tomasz Kupiec, Henryk Głąb, Wojciech Branicki and Manfred Kayser. **Bona fide colour : DNA prediction of human eye and hair colour from ancient and contemporary skeletal remains**. Investigative Genetics. 2013. 4:3