

A History of DNA Analysis in North Carolina

This document was prepared by Forensic Resource Counsel Sarah Rackley Olson. The sources of information are a review of published cases, a review of SBI procedures and protocols, information published on the DNA.gov website and interviews with attorneys. Several dates included are best estimates. The State Crime Lab should be contacted before relying on any specific date. Any additions or corrections to this document should be sent to Sarah.R.Olson@nccourts.org.

Summary:

In November 1988, DNA analysis using the restriction fragment length polymorphism (RFLP) method was performed by Cellmark Laboratories for a NC case. This was the first use of DNA evidence found in a reported North Carolina case. RFLP methods required a larger sample of DNA (50-500 ng) than current polymerase chain reaction (PCR) methods do (0.1-1 ng). The SBI was performing microscopic analysis of hair and spermatozoa as well as blood grouping analysis at this time, but not DNA analysis.

Around 1988 or 1989, the SBI lab started validating the RFLP procedure. In 1989, the SBI lab started performing DNA testing on blood, semen, vaginal fluid and saliva case samples. Using RFLP analysis, the SBI lab compared 4 loci (locations). Prior to the SBI being able to perform DNA analysis, it seems that the lab did not have a written policy of sending the samples out to other labs for testing – instead, the analysts would advise law enforcement agencies that another lab may be able to perform the analysis. If DNA typing of tissue, bone and hair root was requested by the requesting agency during this period, the SBI would refer the case to private testing labs.

By 1994 or 1995, PCR analysis was available at LabCorp, but not at the SBI lab. In 1994 or 1995, the SBI lab began using an RFLP method that tested for 6 loci. In 1994, LabCorp performed DNA analysis on samples in the Darryl Hunt case using a PCR method that compared 10 genetic markers. Around this time (between 1994 and 1997), the FBI performed mitochondrial DNA analysis and microscopic sequences on hairs in *State v. Underwood*, 134 N.C. App. 533 (1999). The FBI still performs mitochondrial DNA analysis for the SBI.

Around 1996, the SBI lab began performing gel-based STR analysis using 3 loci. In 1998, the SBI lab expanded to 8 gel-based STR loci and a gender marker. In 1999 the lab began using exclusively the STR method which compared 12 loci, and RFLP was discontinued. In 2000, the SBI lab expanded to 14 gel-based STR loci and a gender marker. Between 1997 and 2000, commercial labs began performing DNA analysis on hairs for NC cases. In 2004 the lab changed to capillary electrophoresis (CE). CE was first used in casework by the SBI lab in the George Goode case. CE compared 15 STR loci and a gender marker. In 2006 or 2007, the SBI lab began analyzing “touch DNA.” As late as 2005, the SBI sent hair evidence to LabCorp for nuclear DNA analysis, but currently performs this analysis in house.

Timeline:

- 1976 SBI trace evidence section began performing microscopic analysis of hair (not DNA analysis).
- 1984 SBI lab performs microscopic exams for presence of spermatozoa and blood grouping analysis. Fingernail scrapings are collected by police but not analyzed in at least one case (per Darryl Hunt lab reports).
- 1985 DNA profiling described by English geneticist Alec Jeffreys. The technique used by Dr. Jeffreys to examine the Variable Number Tandem Repeats (VNTRs) was called restriction fragment length polymorphism (RFLP) because it involved the use of a restriction enzyme to cut the regions of DNA surrounding the VNTRs. (source: www.dna.gov) VNTR fragments are separated by slab gel electrophoresis, transferred to a nylon membrane by Southern blot technique, and labeled by radioactive or luminescent probes for further detection.
- 1985 Forensic DNA typing was first used in casework in the United Kingdom. (Source: National Resource Council I, DNA Technology in Forensic Science, 1992.)
- 1986 Forensic DNA typing was initiated in the United States in late 1986 by commercial laboratories using RFLP method. (NRC I) PCR was first conceived by Kerry Mullis in 1983, though the first paper on the technique was not published until 1985.
- 1987 In Dwayne Allen Dail case (NC), hair evidence was collected for microscopic identification.
- 1988 Forensic DNA typing was used by the FBI. (NRC I). The SBI lab started validation on RFLP in 1988 or 1989.
- 11/88 SBI lab submitted a vaginal swab and a cutting from a bedspread to Cellmark Laboratories for RFLP analysis in *State v. Pennington*, 393 S.E.2d 847 (1990). The DNA evidence was admitted at trial. Defendant's expert witness testified that the PCR analysis employed by another commercial laboratory would yield results "less equivocal" than those obtained by RFLP analysis.
- 1989 SBI lab began working DNA cases.
- 1989 First conviction overturned by DNA (Chicago case of Gary Dotson).
- 1989 SBI sent vaginal swab to Cellmark Laboratories for DNA analysis. No profile developed. (Darryl Hunt case)
- 1989 Between 1987 (date of offense) and 1989 (trial), SBI lab sent Defendant's socks and victim's bandana to Cellmark Diagnostics for DNA analysis. *State v. Mills*, 332 N.C. 392 (1992).

- 1991 SBI lab began using RFLP (4 markers) in casework and continued using the 4-marker technique for approximately the next four years.
- 1991 The first Short Tandem Repeat (STR) paper was published. STRs have 2–7 base pair long repeat units and their total length is significantly shorter than VNTRs, which are usually between 100 and 450 base pairs. Based on PCR technology, the STR method requires smaller amount of template DNA (typically, 1 ng). It permits analysis of partially degraded DNA as the fragments of interest are short and have more chances to stay intact compared to VNTR.
- 1992 Thomas Caskey and colleagues published the first paper suggesting the use of STRs for forensic DNA analysis. Promega corporation and Perkin-Elmer corporation in collaboration with Roche Molecular Systems independently developed commercial kits for forensic DNA STR-typing.
- 1992 In response to concerns about the practice of forensic DNA analysis and interpretation of the results, the National Research Council Committee on Forensic DNA published DNA Technology in Forensic Science. (NRC I)
- 1994 Roche Molecular Systems released a set of five additional DNA markers (“polymarker”) to add to the HLA-DQA1 forensic DNA typing system.
- 1994/95 SBI began using a 6-marker RFLP technique, which it continued using for about 2 years.
- 1994 Mark Rabil and Ben Dowling-Sendor filed motion for DNA testing in Darryl Hunt case. LabCorp was going to perform the PCR analysis for Hunt case because the SBI lab was not yet using PCR, but was still using the RFLP technique.
- 1994 The science of DNA was made famous in when prosecutors heavily relied on DNA in the O. J. Simpson case.
- 1995 Ronald Cotton case (NC) – DNA analysis showed Cotton did not rape the victim in this 1984 case.
- 1995 Vaginal swab and several known blood samples sent from SBI lab to LabCorp for DNA analysis in Darryl Hunt case. PCR analysis was performed, comparing 10 loci.
- 1996 SBI lab was performing STR analysis using 3 loci, gel based.
- 1996 In *Tennessee v. Ware*, mitochondrial-DNA typing was admitted for the first time in a U.S. court.

- 1996 In response to continued concerns about the statistical interpretation of forensic DNA evidence, a second National Research Council Committee on Forensic DNA (NRC II) was convened and published *The Evaluation of Forensic DNA Evidence*.
- 1997 Police collected hairs from car in Feb 1994. FBI performed mtDNA analysis and microscopic sequences on hairs. Analysis occurred between 1994 and 1997. *State v. Underwood*, 134 N.C. App. 533 (1999).
- 1997 Keith Brown (Wilson Co., NC) was exonerated by DNA analysis which matched the DNA profile from rape victims to the actual perpetrator.
- 1997 Jerry Lee Hamilton convicted (NC). Trial in 1997 included DNA evidence. Post-conviction DNA testing showed Hamilton's nephew's DNA present (different result from the 1997 testing).
- 1998 SBI lab expanded to 8 STR loci and a gender marker, gel based.
- 1998 An FBI DNA database, NIDIS, enabling interstate cooperation in linking crimes, was put into practice.
- 1999 SBI lab discontinued use of RFLP analysis and began using gel electrophoresis exclusively. The new kit tested for 12 markers.
- 2000 SBI lab expanded to 14 STR loci and a gender marker, gel based.
- 2000 Between 1997 (date of offense) and 2000 (trial), Defendant gave blood, hair and clothing samples. DNA testing performed on hair. *State v. Rogers*, 355 N.C. 420 (2002).
- 2000 Between 1998 (date of offense) and 2000 (trial) analysis performed on hair with root *State v. Jones*, 147 N.C. App. 527 (2001).
- 2001 SBI did not have any procedures for DNA-testing of hair in 2001.
- 2003 LabCorp performed DNA testing on hair. *State v. Ryals*, 179 N.C. App. 733 (2006).
- 12/03 Paper envelope and cigarette butts in Darryl Hunt case sent to SBI lab for DNA analysis.
- 2004 Capillary Electrophoresis was used in first case by SBI lab (George Goode case) with 15 loci and a gender marker. In 2004, both gel electrophoresis and CE were being used. Gel electrophoresis was phased out around 2005.
- 2005 Between 2002 (date of offense) and 2005 (trial), mitochondrial DNA analysis performed in Eric Lane (NC) case.
- 2005 LabCorp performed DNA testing on hair. *State v. McAllister*, 190 N.C. App. 289 (2008).

2006/07 SBI began analyzing Touch DNA which it previously sent out to LabCorp.

2009 Between 2007 (date of offense) and 2009 (trial), SBI lab sent hair sample to LabCorp for mitochondrial testing. *State v. Miller*, NO. COA09-1702 (2010).

2011 SBI Lab has 4 CE machines. All mitochondrial DNA analysis is still performed by the FBI.