An Introduction to Y-STR Testing

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Y-STR and Mitochondrial DNA Analysis
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What is DNA?

- DNA = deoxyribonucleic acid

- DNA is the instruction manual for your body – it makes us who we are

- Inherit ½ of DNA from your dad and ½ of DNA from your mom

- Everyone has a unique DNA profile, with the exception of identical twins!
DNA is found throughout your entire body

- Blood
- Semen
- Saliva
- Urine
- Hair
- Teeth
- Bone
- Tissue
- Skin
What Can be Tested?

Essentially any item of evidence with biological material can be tested for DNA:

- Sexual assault swabs
- Fingernails
- Clothing
- Hairs
- Items that have been touched or handled (ex: weapons such as guns, knives, etc.)
- Ligatures used for strangulation
- Stains collected from an object or surface
- … the list goes on and on
3 Primary Types of DNA Testing

- **STRs:**
  - Widespread acceptance in the forensic community
  - Used in labs across the US and internationally
  - Virginia Department of Forensic Sciences

- **Mitochondrial DNA:**
  - Specialized DNA test: widespread acceptance in the forensic community
  - Used in labs in the US and internationally
  - Virginia Department of Forensic Sciences

- **Y-STRs:**
  - Specialized DNA test: widespread acceptance in the forensic community
  - Used in labs across the US and internationally
  - Currently not used by the Virginia Department of Forensic Sciences
What is STR Testing?

- Type of testing performed in crime labs
- Examines female and male DNA
- Look at 13 different areas of the DNA (on multiple chromosomes) to develop an STR profile
- Can pinpoint 1 person in the world (except identical twins)
What is Y-STR Testing?

- Methods used are very similar to those used in STR testing.
- However, Y-STRs only examine MALE DNA.
- Ignores female DNA.
- Look at 17 areas of the Y chromosome to develop a Y-STR profile.
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- Began Y-STR testing in 2002
- Y-STR testing in >500 cases, US and abroad
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- Y-STR testimony provided >20 times
  - Texas, Oklahoma, Michigan, Massachusetts, Colorado, Ohio, Kentucky, California, Florida, New Mexico, Indiana
  - ~5 admissibility hearings: all successful

- Use commercially available Y-STR kits → more standardization between laboratories
Advantages and Limitations of Y-STR Testing

- Y-STR testing cannot uniquely identify an individual
  - Men get their Y chromosome directly from their fathers
  - All men from the same lineage will have the same Y-STR profile
- Statistics: less discriminating than conventional STRs
  - Perhaps 1 in ~3500 (this will soon be 1 in ~14,000)
  - Powerful in their ability to exclude a suspect
  - Cannot search for a Y-STR profile in CODIS, the convicted offender database
- Male specific DNA test!
When should Y-STR testing be used?

- **Majority of cases:**
  - Y-STRs are used after more conventional DNA testing (STR) is attempted or if screening indicates little male DNA is present.

- **Minority of cases:**
  - Y-STR testing may be the 1st type of testing used.
  - Substantially larger amount of female than male DNA (high ratio of female: male)
  - Very small amounts of male DNA
Y-STR Testing May be Useful in Sexual Assault Cases

- Large amounts of female DNA and small amounts of male DNA (ex: sexual assault swabs)
  - Sometimes the male DNA hides behind the female’s profile
  - Male DNA is completely obscured or difficult to interpret

- No or few sperm cells
  - Includes seminal fluid from vasectomized males
  - Male DNA can be detected from epithelial cells in ejaculate, even if sperm are not present

- Male saliva collected from female’s body
  - Example: only oral contact is reported by the victim
Y-STR Testing May be Useful in Homicide Cases

- Mixture of male and female blood
  - Example: suspect allegedly cuts himself while stabbing a female victim
- Fingernail clippings from a female victim
  - Often a large amount of female DNA
- Ligatures used for strangulation – contact DNA from male

- In most of these examples, the amount of female DNA may overwhelm the male DNA.
- In most of these examples, STRs are attempted 1st
  - Y-STRs are often used as a second step in the DNA testing process
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- Of the total casework: only ~5-10% is Y-STR testing

- Of the Y-STR casework: only 10-15% is at the request of the defense (including post-conviction)

- What does this mean?
  - For every 100 DNA cases, ≤1 case is post-conviction Y-STR testing
Case Example #1: Panty cutting

- Previous STR testing performed at state crime lab
- Only detected female DNA from the panty cutting
  - Classic Y-STR case: female DNA obscures the DNA profile from the male contributor (ratio of female: male is too high!)
Case Example #1: Panty cutting

Using Y-STRs “uncovers” the male DNA!
Case Example #2: Vaginal smear sample

- Limited male DNA present on a challenging sample
- Possible degradation of DNA
Case Example #2: Vaginal smear sample

These are only 2 examples of exonerations based on Y-STRs – there have been multiple others!
Things to Keep in Mind…

- If you can get STR DNA testing results, do it!
  - STRs are highly discriminating and detect both female and male DNA!
  - STR results are uploadable into the CODIS database, Y-STRs aren’t!
  - Y-testing should typically be reserved for cases when STR testing fails or is inconclusive

- Y-STR testing cannot uniquely identify an individual
  - All men from the same male lineage have the same Y-profile

- Y-STR testing can provide extremely valuable genetic information when other testing has failed, is inconclusive, or not appropriate based on the case/sample type
Contact Information

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