



B198 Criminal Paternity DNA Testing of Microscopically Identified Chorionic Villi in Formalin-Fixed Paraffin-Embedded Products of Conception

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After attending this presentation, attendees will understand an effective method of DNA extraction of early abortion materials for the purpose of obtaining embryo/fetal DNA profile information.

This presentation will impact the forensic community and/or humanity by introducing the effectiveness of combining the techniques of microscopic-identification of chorionic villi and DNA extraction of formalin-fixed, paraffin-embedded early abortion materials. This will aid in generating complete embryo/fetal DNA profiles to utilize for discriminating criminal paternity comparisons. The primary application is for statutory rape cases where intercourse was consensual but illegal, and other associative biological evidence was not recovered due to the time frame of discovery.

Prior to 2002 and this research, early abortion material cases were not consistently or methodically pursued in Michigan State Police Laboratories. In early abortions, embryonic/fetal anatomy is not easily identified due to the abortion process and/or the developmental stage. Random sampling of the tissues for DNA analysis was utilized and often results were only maternal due to the overwhelming ratio of maternal decidua to embryonic/fetal tissue. Recent research identified a procedure to microscopically-identify embryonic/fetal tissues from early abortion materials. The procedure included formalin-fixation of the tissue; however this process is known to cause problematic STR DNA analysis, especially with exposures longer than 12–24 hours. In early 2003, the Michigan State Police Lansing Laboratory and Sparrow Hospital's Department of Pathology, Lansing, MI partnered to compare two different methods for the extraction of formalin-fixed, paraffin-embedded, and microscopically-identified chorionic villi (embryonic placental tissues).

The resultant embryonic/fetal tissue and maternal decidua from an early term elective and multiple spontaneous abortions were examined for identifiable embryonic/fetal anatomy—with none identified. The specimens were divided into a total of 50 sections and were formalin-fixed, paraffin-embedded, sectioned, stained, and mounted for microscopic examination. Chorionic villi were microscopically-identified for STR DNA analysis. Xylene deparaffinisation and tissue lysis buffer digestion were employed prior to DNA extraction to maximize the release of DNA from the tissue substrates. Since past extraction efforts utilizing traditional organic methods from formalin-fixed tissue often resulted in poor-quality degraded DNA and/or limited recovery of viable DNA for amplification, two extraction procedures, Chelex® and phenol/chloroform/isoamyl alcohol (organic), were compared in ability to recover the highest quantity and best quality DNA.

Results from the extractions revealed that significantly higher quantities of DNA were obtained from the Chelex® extracted samples, as well as significantly higher quality DNA profile information (full Profiler Plus™/COfiler™ profiles). The STR results exhibited varying proportions of embryonic/fetal and maternal alleles—from single-source profiles to an equal mixture of contributors. Upon discernment of the offspring profile, aided by comparison to the maternal reference sample profile, comparison to the putative father was possible for determination of association. In actual casework, subsequent calculation of a likelihood ratio would assign statistical strength to the association.

The Chelex® extraction method for this application was implemented in early 2004 at the Michigan State Police Lansing Laboratory. The methods for quantification, amplification, and capillary electrophoresis had been validated and utilized for casework prior to this research; therefore, validation of the extraction procedure was quick and simple, and should be for other laboratories as well. At the current time the procedure is conducted at the Lansing facility exclusively; however, the Michigan State Police Laboratory system is working to train personnel at each of its three DNA laboratories. The caseload is approximately 10–15 cases per year in the Lansing Laboratory service area. Since implementation, at least five cases have been adjudicated with resultant convictions of Criminal Sexual Conduct in the Second Degree (CSC II) or Criminal Sexual Conduct in the Third Degree (CSC III) as a direct result of analysis. Sentencing ranged from 3 years probation to 15 years incarceration.

DNA Extraction, Formalin-Fixation, Chorionic Villi