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Supremacy of STR –UMDNA Based Han Identity Testing A Comparison with other Forensic Testing

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ABSTRACT

The genetic relationship of the mother is rarely questioned but disputes over who may be the true biological father occur with some frequency. Previously Serological techniques were used in which a battery of blood group systems was needed to attain the level of discriminations to determine paternity beyond reasonable doubt. More recently STRs have been used although a large number of STR loci are required. The reason for the change from conventional typing to STR-DNA method is the high degree of probability obtained and the automation of the test. The efficacy of DNA- typing (STR-Typing) in terms of definite opinion (inclusion or exclusion) with other Forensic biological testing like Anthropology and Serology was probed and found that DNA-Typing was observed with 100% success rate than other testing in solving paternity cases more specifically.

KEYWORDS: Genetics, Forensic, STR, serology and DNA probe.

INTRODUCTION

A DNA laboratory can be asked to determine whether a man is the Biological father of a child. The genetic relationship of the mother is rarely questioned but disputes over who may be the true biological father occur with some frequency. Previously Serological techniques were used in which a battery of blood group systems was needed to attain the level of discriminations to determine paternity beyond reasonable doubt. More recently STRs have been used although a large number of STR loci are required. The reason for the change from conventional typing to STR-DNA method is the high degree of probability obtained and the automation of the test. For any biological test it is possible to determine the probability that two individuals taken at random from a defined population will be identical with regard to the genetic marker examined (Nata *et al.*, 1993). The power of the test is measured either the probability of identity or the probability of a match. In a civil or criminal case in most jurisdictions, the court is concerned with the finding between the case presented by the plaintiff and that presented by the defendant. This is to be decided upon by the balance of probabilities. Hence the test with the value of higher probability gains much significance as scientific evidence in judicial system.

Uncertainty is best measured by probability. An excellent description of probability and its role in Forensic science has been given by Findlay *et al* (1997). There are several laws of probability which describe the values that probability may take and how probability may be combined. All probabilities may be thought of as conditional probabilities. In other words, the probability of an event happening is conditional on the knowledge of other events and background data or information. Similarly the probability of a hypothesis such as the guilt of a suspect, is conditional on the knowledge of a events and of background data or information such as the experiences brought to the assessment by individual jurors. The probability attached to uncertain scientific evidence is conditioned on the background data or information relevant to the type of evidence being assessed. For example evidence concerning frequencies of DNA-profile (DNA – typing) will be conditioned on information regarding ethnicity of the people concerned for the value of these frequencies, that is population data.

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Experimental attempts to determine discriminating power are described by Butler et al., (2003) for paint fragments for human head hairs and for the foot wear prints. The probability that they are not found to match with respect to their characteristic is known as the probability of discrimination or discriminating power. This idea was first applied to problems concerning ecological diversity, later to blood group genetics and the applications to DNA profiles is given by Jeffreys et al., (1985). Various methods have been used to present the evidence of a relative frequency in court. For DNA profiling likelihood ratio is the best way to present the evidence. The likelihood ratio can be shown mathematically to be the only way to present evidence. Unfortunately the method of presentation appears to cause confusion and educations is needed to rectify this. A likelihood ratio (LR) involves a comparison of the probabilities of the evidence under two alternative propositions. These two propositions are often referred to as the null hypothesis and the alternative hypothesis. In Forensic DNA settings these mutually exclusive hypotheses represent the position of the prosecution namely the DNA form the crime scene originated from the suspect – and the position of the defense that the DNA just happens to coincidently match the defendant and is instead from an unknown person out in the population large.

$LR = H_p/H_d$

H_p = Hypothesis of prosecution

H_d= Hypothesis of defense

As the DNA – typing has revolutionized the Forensic criminal testing with higher probability, it has been planned to compared the efficacy of STR – Typing with other biological testing like Anthropological and Serological testing that are employed for human identify testing in Forensic Sciences Department. TamilNadu.

MATERIALS AND METHODS

In order to determine the validity or efficacy of STR – Typing, 1100 cases with 1541 exhibits received for Anthropological testing, 2808 cases with 12803 exhibits received for Serological testing and 555 cases and 1665 exhibits received for DNA – typing that were tested during the year 2004 to 2008, at Forensic Sciences Department, Tamil Nadu were undertaken and analyzed. The results of above three testing in terms of their merit (i.e.) definite opinion of results was generated and a comparative statistics with the objective of assessing the efficacy of Forensic DNA-testing was done.

RESULTS AND DISCUSSION

Anthropological studies on aboriginal population help to identify their relationship with other tribes. Anthropological and genetic studies based on classical markers suggested a close affinity between the Andaman Tribes and Negritos of South East Asia rather than with African pygmies. For Anthropological testing to confirm the identity of the unknown, exhibits like skull, bones, teeth and other stable body parts were used. These body parts were used to find out age, sex and race of the individuals. The pieces of bones collected as evidence were tailored to find out the shape and skeletal architecture of the suspects. To find out Anthropological similarity various skeletal evidences were collected and submitted to Anthropological unit of Forensic Sciences Department for analysis. In the year 2004, 307 exhibits were analysed for 203 cases. The number of exhibits analysed during 2004-2008 are given in figure 1.

The reports submitted to identify the suspect using Anthropological exhibits could not confirm the identity. During the study period, 2004-2008, 1100 cases were investigated using Anthropological exhibits, however no conclusive opinion was arrived and this method of identifying the suspects remain fruitless. However these Anthropological exhibits can be used to study the molecular constituents to match the identity. Like Anthropological analysis, Serological testing is also used to identify the suspects. Serological features such as low profile of blood pressure, pulse rate, and very low frequency to absence of B-gene in ABO blood group helped to find out close relationship between two aboriginals, jarawas and onges of Andaman Islands (Kumari, 1994). The year-wise receipt of cases with Anthropological exhibits submitted to Anthropological

Division were examined for Anthropological testing like super imposition of skull and age and sex determinations of bones like, tibla, fibula femur pelvic girdles, etc.. Two hundred and three cases with 307 exhibits during 2004, 236 cases with 247 exhibits in 2005, 179 cases with 273 exhibits in 2006, 225 cases with 370 exhibits in 2007 and finally 227 cases with 344 exhibits in 2008 that were represented as histogram. (Fig 1).

The Serological testing conducted for 2808 cases during with period 2004 to 2008 at Serology Division for blood typing study also showed partial identity. About 555 cases with 2574 exhibits in 2004, 595 cases with 2760 exhibits in 2005, 485 cases with 2218 exhibits in 2006, 588 cases with 2654 exhibits in 2007 and 585 cases with 2597 exhibits in 2008, showed no valid conclusion for disputes. (Fig.2). Serological testing helped to give the right results for only 61.4% of the cases. A total of 555 paternity cases were received in DNA laboratory where STR – DNA Typing was conducted, during 2004 – 2008. In the 108 cases with 324 exhibits received during the 2004, 119 cases with 357 exhibits in 2005, 110 cases with 330 exhibits in 2006, 108 cases with 324 exhibits in 2007 and 110 cases with 330 exhibits in 2008, (Fig.3). 15 autosomal STR- Typing was carried out. The results of the 15 autosomal STR- Typing was perfectly correct in all the cases (100%). (Fig.4).

The ultimate objective of this study was to highlight the power of identity or discrimination or probability of STR – DNA Typing method of calculation of identity or probability for a particular marker was first described by Jones (1972). It was also reported that the average power of probability for Serological technique using seven systems such as ABO, Rh, MNS, PGM, Erythrocyte and phosphatase (EAP) haptoglobin (Hp) and group specific component (Gc) is only 0.9977% whereas in disputed paternity cases, 15 markers were routinely used to obtain a probability of paternity greater than 99.9% (Forensic Med. 2003). The same way the present study was undertaken to calculate the efficacy of STR – Typing in comparison with the Serological and Anthropological testing that were carried out. The comparative statistical analysis, showed the greater probability power of 100% for STR- Typing in paternity cases. 61.4% for Serological testing and 0% for Anthropological testing with regard to definite opinion arrived on results generated (Kimpton, 1992).

The present study also revealed the scientific concept behind achieving hundred percent results (in terms of definite opinion) of either match or exclusion of DNA – profiles in disputed paternity. This was due to the sensitivity and efficacy of the test with the application of polymorphic markers, as well as the fresh, uncontaminated blood samples subjected for testing. Further a definite opinion could not be worked out in other Forensic testing like Serology and Anthropology, analyzed in this study. The present study obviously determined that STR–Typing as an excellent biotechnological tool with greater probability and wider application for DNA. Scientists working with modern Forensic DNA – laboratories can solve paternity cases easily and at the same time the traditional testing/techniques of both serology and Anthropology still hold good with its validity in situation wherein DNA – test could not be carried out.

Conclusion

In this dissertation paternity dispute – a crime against women in Tamil nadu was studied in detail and evaluated that this dispute is observed more among the socially weaker section scheduled caste population. The biological mothers of this dispute in the age-group of 18-37, were identified as major victims belonging to different castes in Tamil Nadu. Further analysis of educational status revealed that paternity dispute was seen more among girl / women with school level education and then illiterates of all castes in Tamil Nadu. This study has also sought to ameliorate one of the greatest limitations encountered in the current autosomal STR-Typing for human identity testing conducted in Forensic Sciences Department, Tamil Nadu- lack of local population STR-DNA data generally used for statistical calculations for arriving paternity index. Four hundred and twenty individuals from Tamil populations belonging to Forward class population, Backward class population, Most backward class population and Scheduled caste population were typed for 15 autosomal STR-markers (loci) with allele frequencies alleles range, rare alleles, variant alleles, genotype frequencies and hetrozygosities. The allele frequencies and rare alleles for 15 autosomal markers of Tamil

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populations typed in this study, showed a marked variation in frequencies when compared with the population data currently being used for statistical calculation in human identity testing employed in DNA laboratory of TamilNadu. Further efficacy of DNA- typing (STR- Typing) in terms of definite opinion (inclusion or exclusion) with other Forensic biological testing like Anthropology and Serology was probed and found that DNA-Typing was observed with 100% success rate than other testing in solving paternity cases more specifically.

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Fig 1 Histogram showing Anthropological testing undertaken during 2004-2008 at Forensic Sciences Department, Tamilnadu, India.

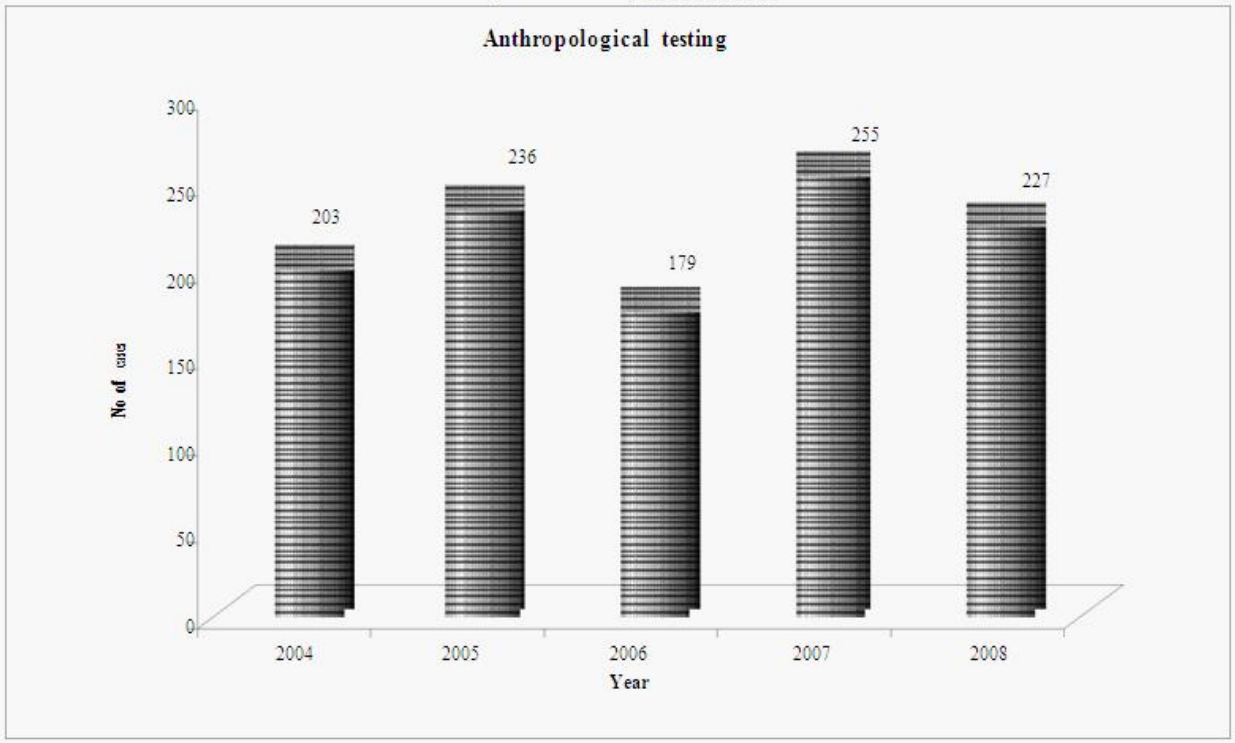

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Fig 2 Histogram showing Serological testing undertaken during 2004-2008 at Forensic Sciences Department, Tamilnadu, India.

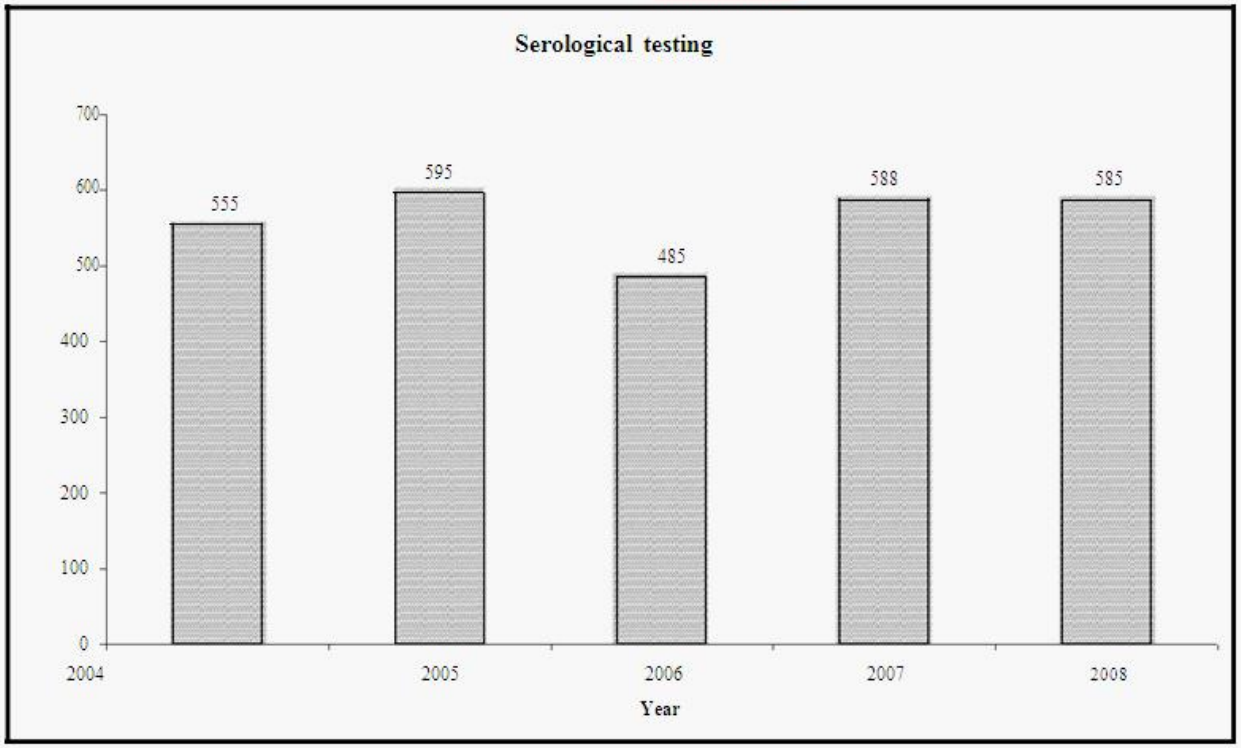

Fig 3 Histogram showing DNA-Typing in paternity cases undertaken during 2004-2008 at Forensic Sciences Department, TamilNadu, India.

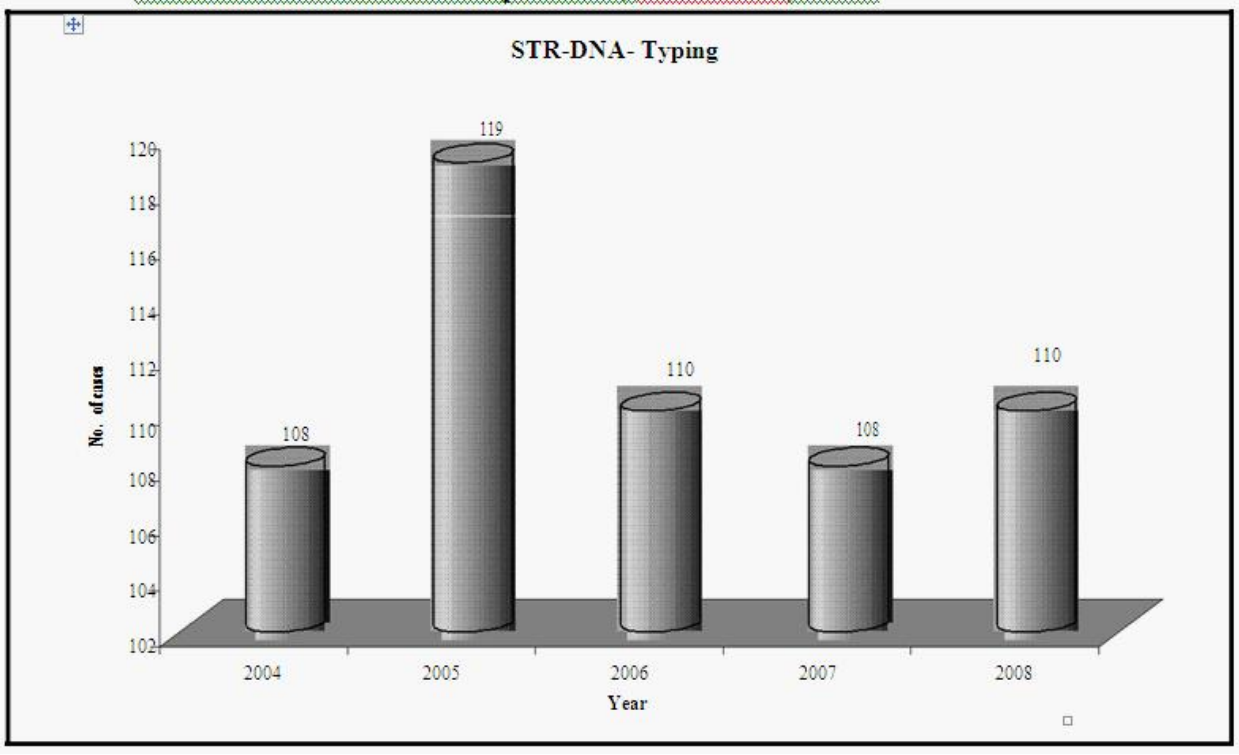

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Fig 4 Histogram showing comparative probability assessment of STR-Tying with other Forensic Biological testing undertaken during 2004-2008 at Forensic Sciences Department, Tamilnadu, India.