International Congress Series 1261 (2004) 523–525

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Paternity determination of the deceased defendant in STR against RFLP analysis ☆

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Abstract. This work shows a paternity examination a deceased defendant carried out on the basis of his two sisters DNA profile determination. STR and RFLP analyses were used and their efficiency was compared. The statistical evaluation proved the defendant's paternity with the probability of more than 99,999% (PI>100,000). The restriction analysis appeared considerably more informative than the amplification one, which means seven RFLP markers correspond with the same paternity indices to the 15 STR markers.

Keywords: Deficiency case; Paternity determination; Statistical approach; RFLP/STR analysis

1. Introduction

Paternity determination cases, where the DNA profile of the defendant is not available, belong to the cases of the highest level of difficulty. Considerably larger sets of genetic markers have to be examined than in standard casework and the statistical evaluation of the DNA evidence is more difficult [1].

The aim of this work was to check the differences between RFLP and STR methods in the value of the paternity index in the deficiency case in which, instead of the defendant, his two sisters were investigated.

2. Materials and methods

The paternity determination in the deficiency case was carried at the Department of Forensic Medicine, Medical University of Lodz, Poland. Samples of blood were taken from two sisters of the deceased alleged father as well as from the child and the child's mother. DNA was isolated with the use of the salt extraction procedure as described by Lahiri [2]. Amplification of 15 STRs was performed using the Identifiler system (Applied

☆ This project was supported by the Medical University of Lodz grant no. 502-11-702.

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0531-5131/
doi:10.1016/S0531-5131(03)01650-9

Biosystem) with detection on ABI Prism 377 sequencer. For minisatellite (RFLP) analyses, DNA was restricted with *Hin*dI and hybridized single locus probes (SLP): MS31 (D7S21), MS43A (D12S11), MS1 (D1S7), TBQ7 (D10S28), YNH24 (D2S44), G3 (D7S22), D5S43 (MS8) (Cellmark Diagnostics) and analysed with software BIO1D (Vilber Lourmat). Restriction fragments were grouped in fixed bins taking into account the measurement error of $\pm 2.3\%$ [3].

Statistical evaluation was made using the paternity index value (PI) and the probability of paternity [W-Wahrscheinlichkeit] devised by Essen-Möller on the basis of Bayes's theory [4].

3. Results

The genotypes observed in the reported deficiency paternity case with appropriative value of PI for RFLP and STR analyses are given in Table 1.

Table 1
The genotypes and paternity index (PI) in a deficiency case in STR and RFLP analyses

N_{STR}	Locus	S_I	S_{II}	Ch	M	PI value
1	D8S1179	10/12	12/14	12/16	13/16	1.36
2	D21S11	30/32.2	30/32.2	30.2/32.2	30.2/30.2	2.15
3	D7S820	10/12	10/10	8/12	8/10	1.56
4	CSF1PO	10/11	11/11	11/12	10/12	2.19
5	D3S1358	15/18	15/18	16/16	16/17	0.50
6	TH01	9.3/9.3	9.3/9.3	7/9.3	9.3/9.3	0.50
7	D13S317	11/13	11/13	12/13	12/12	3.12
8	D16S539	11/11	11/13	12/13	12/13	0.74
9	D2S1338	24/25	24/25	20/25	20/24	2.02
10	D19S433	13/16	13/13	16/16	15/16	6.25
11	vWA	18/18	17/20	16/18	16/18	1.49
12	TPOX	8/8	8/8	8/10	8/10	0.69
13	D18S51	17/18	17/18	15/18	15/17	3.29
14	D5S818	10/11	10/11	11/13	10/11	0.50
15	FGA	21/23	23/23	21/23	21/23	2.73
Total						335.42
N_{RFLP}	Locus	S_I	S_{II}	Ch	M	PI value
1	D7S21	10.2/8.5	8.5/4.7	8.8/7.3	8.8/–	0.25
2	D12S11	7.4/7.2	7.4/7.2	7.2/7.1	10.6/7.1	6.58
3	D1S7	5.3/2.8	5.3/4.3	7.3/7.1	10.7/7.1	0.25
4	D10S28	1.6/–	4.3/1.6	1.6/1.4	2.0/1.4	4.00
5	D2S44	5.2/3.9	3.9/3.0	5.2/2.6	4.8/2.6	4.17
6	D7S22	7.2/1.6	7.7/1.6	7.8/1.6	7.8/1.6	6.83
7	D5S43	6.6/–	5.5/4.8	6.6/4.7	4.7/2.4	7.69
Total						360.37

$N_{STR/RFLP}$—following number of STR/RFLP loci applied; S_I—first sister of deceased defendant; S_{II}—second sister of deceased defendant; Ch—child; M—mother of child; PI—paternity index value
Sizes of restriction fragments for RFLP loci were given in kb.

4. Discussion

Paternity determination, when the alleged father's genotypes are unavailable, is performed on the basis of his family investigations. The most convenient situation is when the genetic profile of the defendant's both parents can be established. It is much more difficult to investigate a fatherhood status when, instead of the defendant, his siblings or/and his other children are available [5].

In the reported case, we applied seven markers RFLP and a set of 15 STRs to judge the fatherhood status of the deceased man. The statistical evaluation proved the defendant's paternity with the probability of more than 99,999% (PI>100,000). In the child we found very informative (allele frequencies 0.01–0.065) five RFLP alleles shared with the first or/and second sister of the alleged father. After analyzing the seven markers, the paternity value was 99.72%, (PI = 360.37). The corresponding value of paternity indices (W = 99.70%, PI = 335.42) was received for 15 STRs markers. The considerable superiority of PI/W values in RFLP analysis with respect to STR analysis in a parentage testing was reported earlier. Thomson et al. [6] indicate that 16 STR systems are required to provide equivalent paternity indices to the six SLP (RFLP) systems.

5. Conclusion

The authors regard the RFLP analysis as helpful in deficiency cases because it allows to obtain higher value of probability of paternity than the STR analysis, and thus it should remain to be applied when the genetic profile of the defendant is unavailable.

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