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The Application of X-STR: Two Case Reports

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Abstract: The usefulness of the X-chromosomal STRs (short tandem repeats) for forensic purposes seems to be restricted, but may be valuable in some paternity cases. Due to the particular mode of inheritance, X-chromosomal X-STR has the advantage in female traces identification against male contamination and in complex kinship cases, such as deficiency cases (mother-son or father-daughter), grandparent-grandchild comparisons, half-sisters testing, etc. In this study, 4 blood samples from two paternity cases without father were examined with TYPER19 Amplification kit first, from the result, it is hard to judge the relationship between the mother-sons, then TYPERX19 kit was conducted to obtain the full profiles of the two pairs of the mother-son, from the genetypes of the samples, it can be inferred that neither of the two pairs of mother-son were in line with the kinship, which provides important evidence for the two paternity cases. All together, the X-chromosome marks included in the TYPERX19 kit can offer the possibility to solve complex kinship cases where autosomal STR markers cannot provide the information needed.

Key words: X-STR, identification, kinship.

1. Introduction

Paternity trio cases can most easily be solved with autosomal STR (short tandem repeat) markers alone, Y-chromosomal STRs can provide clues for male pedigree investigation, so most forensic interests have been focused on autosomal and Y-chromosomal STRs, while test of paternity duos involving a daughter or more complex family relations could gain from X-chromosomal testing, analysis of X-STR can be beneficial in identification on a trace with female minor component and male major component and in complex kinship cases, such as deficiency cases (mother-son or father-daughter), grandparent-grandchild comparisons, half-sisters testing, paternity testing in incest cases and so forth [1]. TYPERX19 kit is one of the most commonly used kits for X-STR typing, which includes 18 X-STR loci (DXSGATA31E08, DXS10079, DXS10103, DXS7132, DXS9895, DXS7133, DXS7424, DXS7423, DXS6789, DXS9902, DXS6810, DXS8377, DXS101, HPRTB, DXS8378, DXS6797, DXS6804, GATA165B12) and one amelogenin loci. X-STRs have been recognized as important tools in forensic application [2-11]. Especially in some identification of kinship, the test efficiency can be significantly improved by adding the X-STR test when no conclusion can be drawn by the autosomal STR test [12-15]. Therefore, X-STR can serve as an important complement to autosomal STR, Y-STR and mitochondrial DNA [16]. This study introduced two paternity cases, in which X-STR played an important role.

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2. Materials and Methods

Four blood samples from two paternity cases without father were collected from Institute of Forensic Science, Ministry of Public Security, Beijing, China. These two pairs of mother-son were from Sichuan province, the child needs to do kinship identification before registering their household registration. The samples were amplified with TYPER19 and TYPERX19 Amplification kit following manufacturer's recommendations. Gene-Mapper ID-X v1.3 (Life Technologies, USA) was used to determine fragment size and genotyping. Allele peak of 100 relative fluorescence unit (RFU) was implemented as the peak

detection threshold when analyzing data from CE instruments.

3. Results and Discussion

In these two paternity cases, the samples were amplified with TYPER19 (18 autosomal STR and one Amelogenin loci) first, the genotyping of the son is mismatched with that of the mother at D16S539 loci in case 1 (see Table 1), the genotyping of the son is mismatched with that of the mother at D8S1179 and D19S433 loci in case 2 (see Table 2). The mismatch can be probably due to the mutation in these two cases, it is difficult to judge their mother-son relationship, then these four samples were amplified with the TYPERX19, the genotyping was shown in Tables 3 and 4, there were 8 X-STRs that were mismatched in case 1, there were 4 X-STRs that were mismatched in case 2, according to the number of inconsistent loci and the mutation rate of X-STR [17-20], it can be judged that neither of the two pairs of mother-son were in line with the kinship, in the subsequent investigation of the mother-sons, it was confirmed that two pairs of the mother-son were both non-biological, it verified our results. X-STR played an important role in these two cases.

Table 1 The gene-type of the samples in case 1 (amplified with TYPER19 Amplification kit).

	AMEL	D5S818	D21S11	D7S820	CSF1PO	D2S1338	D3S1358
5392-1	X	9,11	30,30.3	11,12	12,14	22,23	16
5392-2	X,Y	9,11	29.2,30	11	13,14	18,23	16,17
	vWA	D8S1179	D16S539	Penta E	TPOX	TH01	D19S433
5392-1	17,18	14,15	11,12	5,13	8	7	14,14.2
5392-2	17	14,15	9,13	13	8,11	7,9	13,14.2
	D18S51	FGA	D6S1043	D13S317	D12S391		
5392-1	13,15	18,24	13,19	10,11	16,17		
5392-2	13,14	24,26	19	10,12	17		

Table 2 The gene-type of the samples in case 2 (amplified with TYPER19 Amplification kit).

	AMEL	D5S818	D21S11	D7S820	CSF1PO	D2S1338	D3S1358
3753-1	X	11,12	29.2,31.2	10,12	12	21,23	15,16
3753-2	X,Y	11,15	29.2,31.2	8,10	12	20,23	15
	vWA	D8S1179	D16S539	Penta E	TPOX	TH01	D19S433
3753-1	16,18	12,16	11	5,12	8,11	7	14.2,15.2
3753-2	18,19	10,13	10,11	12,19	8	7,9	14,15
	D18S51	FGA	D6S1043	D13S317	D12S391		
3753-1	15,16	23,24	14,18	9	18,20		
3753-2	15,22	21,23	18	9,11	18,19		

Table 3 The gene-type of the samples in case 1 (amplified with TYPERX19 Amplification kit).

	AMEL	GATA31E08	DXS10079	DXS10103	DXS7132	DXS9895	DXS7133
5392-1	X	9,12	18,22	16,19	12,14	15,16	9
5392-2	X,Y	11	19	16	13	16	9
	DXS7424	DXS7423	DXS6789	DXS9902	DXS6810	DXS8377	DXS101
5392-1	14,16	15	16,20	10	17,18	49	24,25
5392-2	16	15	19	10	18	49	27
	HPRTB	DXS8378	DXS6797	DXS6804	GATA165B12		
5392-1	13	10	23	12,14	9,11		
5392-2	12	10	24	9	11		

Table 4 The gene-type of the samples in case 2 (amplified with TYPERX19 Amplification kit).

	AMEL	GATA31E08	DXS10079	DXS10103	DXS7132	DXS9895	DXS7133
3753-1	X	10	18,21	16	11,13	13,14	9
3753-2	X,Y	10	20	16	13	17	9
	DXS7424	DXS7423	DXS6789	DXS9902	DXS6810	DXS8377	DXS101
3753-1	15,16	15	16,19	10	18,19	43,48	24,25
3753-2	15	15	16	11	18	48	25
	HPRTB	DXS8378	DXS6797	DXS6804	GATA165B12		
3753-1	12,14	11	24	10,12	10,11		
3753-2	14	12	24	12	11		

4. Conclusions

In the identification of deficiency cases (mother-son or father-daughter), grandparent-grandchild comparisons, half-sisters testing, etc., where autosomal STR markers cannot provide the information needed, X-STR can be added for testing, which can play an important role in these cases.

Conflict of interest

The authors declare that there is no conflict of interest with regard to publication of this article. The institute, from where the data for this study were collected, has been duly acknowledged in the material and methods section.

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