

Research article

How many markers are enough for motherless cases of parentage testing

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Abstract

Using STR markers, motherless cases have been investigated. We focus on the relationship between the probability of exclusion and the value of paternity index. It is emphasized that using the correct formulae for calculating the probability of exclusion is necessary, because the false formulae generally overstate the power of a test battery. We suggest two criteria for paternity inclusion.

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1. Introduction

In motherless cases of parentage testing, only the alleged father and child pairs were tested. The absence of mother sample increased the probability of false paternity inclusion. How to avoid false inclusion of paternity should be considered [1–3]. This work presented simple criteria with this consideration, to analyze motherless cases of parentage testing.

2. Materials and methods

2.1. STR markers and samples of parentage testing

A total of 112 motherless cases of parentage testing were investigated, while they were genotyped in Department of Forensic Genetics, Sichuan University, China. A total of 25 STR markers were employed for this study, which were included VWA, D8S1179, TPOX, FGA, D3S1358, TH01, D21S11, D18S51, Penta E, D5S818, D13S317, D7S820, D16S539, CSF1PO, Penta D, D1S2142, D15S659, D14S306, D13S1492, D18S865, D12S391, D20S161, D3S1754, D4S2366 and D1S549.

2.2. Formulae

The general formulae of parentage testing were employed [1,2]. For calculating the probability of exclusion in motherless cases, the formula [3] was as follows:

$$EP = \sum_{i=1}^n p_i^2 (1 - p_i)^2 + \sum_{j>i=1}^n 2 p_i p_j (1 - p_i - p_j)^2 \quad (1)$$

3. Results and discussion

The calculated results of the probability of exclusion showed in Table 1. The general formula, which was employed to calculate the probability of exclusion for trio, generally overstated the power of a test battery in motherless cases (Table 1). It is emphasized that using the correct formula for calculating the probability of exclusion in motherless cases is necessary.

We focus on the relationship between the probability of exclusion and the value of paternity index (PI). The distributions of paternity index of 112 motherless cases of parentage testing with different number of STR loci were obtained, which showed in Table 2 and Fig. 1. The distributions of the value of PI with different numbers of STR loci overlapped. For evaluation of system power for motherless

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Table 1
The calculated results of the probability of exclusion

	STR loci	Calculation with general formulae		Calculation with formula (1)	
		EP	Combined EP	EP	Combined EP
1	VWA	0.6019	0.601900000000	0.4241	0.424100000000
2	D8S1179	0.6790	0.872209900000	0.5097	0.717636230000
3	TPOX	0.3456	0.916374158560	0.1855	0.770014709335
4	FGA	0.7344	0.977788976514	0.5785	0.903061199985
5	D3S1358	0.4704	0.988237041962	0.2994	0.932084676709
6	TH01	0.4595	0.993642121180	0.2818	0.951223214813
7	D21S11	0.6702	0.997903171565	0.5005	0.975635995799
8	D18S51	0.7204	0.999413726770	0.5610	0.989304202156
9	Panta-E	0.6443	0.999791462612	0.4444	0.994057414718
10	D5S818	0.5582	0.999907868182	0.3792	0.996310843057
11	D13S317	0.6049	0.999963598719	0.4269	0.997885744156
12	D7S820	0.5565	0.999983856032	0.3762	0.998681127204
13	D16S539	0.5675	0.999993017734	0.3887	0.999193773060
14	CSF1PO	0.4656	0.999996268677	0.2955	0.999432013121
15	Panta-D	0.6278	0.99998611202	0.4494	0.999687266424
16	D1S2142	0.5987	0.99999442675	0.4208	0.999818864713
17	D15S659	0.6987	0.99999832078	0.5337	0.999915536616
18	D14S306	0.5730	0.99999928297	0.3945	0.999948857421
19	D13S1492	0.7660	0.99999983222	0.6191	0.999980519792
20	D18S865	0.5629	0.99999992666	0.3839	0.999987998244
21	D12S391	0.7014	0.99999997810	0.5363	0.999994434786
22	D20S161	0.5972	0.99999999118	0.4185	0.999996763828
23	D3S1754	0.4711	0.99999999533	0.2964	0.999997723029
24	D4S2366	0.5355	0.99999999783	0.3575	0.999998537046
25	D1S549	0.6139	0.99999999916	0.4370	0.999999176357

cases of parentage testing, the probability of exclusion seems to be a more sensitive parameter.

We suggest two criterions for paternity inclusion in motherless cases of parentage testing. They are the probability

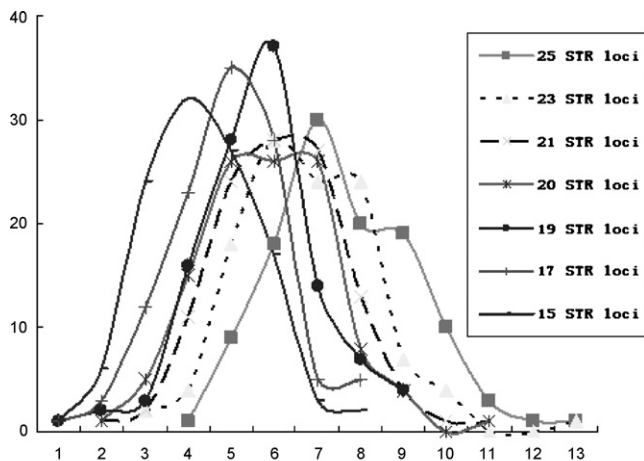


Fig. 1. The distributions of paternity index of 112 motherless cases of parentage testing 1 = PI from 10 to 100, 2 = PI from 100 to 1000, 3 = PI from 1000 to 10,000, 4 = PI from 10,000 to 100,000, 5 = PI from 100,000 to 1,000,000, 6 = PI from 1,000,000 to 10,000,000, 7 = PI from 10,000,000 to 100,000,000, 8 = PI from 100,000,000 to 1,000,000,000, 9 = PI from 1,000,000,000 to 10,000,000,000, 10 = PI from 10,000,000,000 to 100,000,000,000, 11 = PI from 100,000,000,000 to 1,000,000,000,000, 12 = PI from 1,000,000,000,000 to 10,000,000,000,000, 13 = PI from 10,000,000,000,000 to 100,000,000,000,000.

Table 2
The value of paternity index (PI) with different numbers of STR loci

The number of STR loci employed	The minimum value of PI	The maximum value of PI
15 STR loci	52.8	751507000.7
17 STR loci	14.2	652968413.3
19 STR loci	96.6	9836710237
20 STR loci	178.6	5.40307E+11
21 STR loci	123.3	7.46272E+11
23 STR loci	2040.1	1.63369E+13
25 STR loci	45,129	4.31082E+13

of exclusion and the paternity index. The threshold value of the combined probability of exclusion was suggested as 0.9999, while the threshold value of the paternity index was suggested as 10,000 for paternity inclusion. The scientific evidence for paternity testing can be obtained when both the combined probability of exclusion and the paternity index meet the threshold values. However, when either the combined probability of exclusion or the paternity index can not meet the threshold values, more genetic markers should be added.

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Conflict of interest

None.

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