TECHNICAL NOTE

Cyril J. Thomas,[1] *T. J. v. W. Kotze,*[2] *and J. M. Nash*[2]

The Palatal Ruga Pattern in Possible Paternity Determination

REFERENCE: Thomas, C. J., Kotze, T. J. v. W., and Nash, J. M., **"The Palatal Ruga Pattern in Possible Paternity Determination,"** *Journal of Forensic Sciences*, JFSCA, Vol. 31, No. 1, Jan. 1986, pp. 288-292.

ABSTRACT: The use of a genetic marker in paternity determination has been successful with the ABO blood group system but unsuccessful in dermatoglyphics and palatal rugae because the genetic mechanism is polygenic. The palatal rugae of 17 families (34 parents and 49 children) were classified and recorded, and the data used to construct a statistical analysis system (SAS) cluster map. A positive result would have meant a father clustering with all his children at Level 83, where, in fact, the best result achieved was at Level 5. The best cluster occurred at Level 82 between the ten-year-old boy of Family 7 and the eleven-year-old girl of Family 3. It is thus clear that the palatal rugae cannot be used in a practical procedure to determine paternity.

KEYWORDS: pathology and biology, palatal rugae, paternity

The handing down of anatomical features from parents to children is part of the genetic mechanism of inheritance. In particular, the transferring of a genetic marker from father to children forms the basis of identifying a father in disputed paternity cases.

The use of the ABO blood group systems in this regard is a well-known procedure. It is simple and practical because the inheritance mechanism is mendelian monogenic [*1*]. On the other hand, the study of dermatoglyphics, although a very useful forensic science tool, has shown that inheritance is a complicated polygenic process and no single marker can be identified for tracing back to a child's father. On a population basis, however, a high degree of correlation exists between parents and offspring ($r = 0.48$) and between siblings ($r = 0.50 \pm 0.04$), but between the two parents it was $r = 0.05 \pm 0.07$ (not significantly different from zero). This indicates that almost all the observed variation in the population can be attributed to additive nondominant genetic variation and little, if any, to environmental effects [*2*].

In a previous study of the palatal rugae [*3-7*], these structures were found to be very closely equivalent to dermatoglyphs regarding, among other properties, total individuality, an identifiable population average, accessibility (that is, surface position easily available for recording), and gross morphology lending itself to reading without special apparatus.

In the search for genetic markers for use in paternity determination, it was considered a possibility that a trait(s) in the rugae could be identified as heritable.

Received 9 Feb. 1985; accepted for publication 2 May 1985.

[1]Faculty of Dentistry, University of Stellenbosch, Tygerberg, South Africa.
[2]Institute for Biostatistics, S. A. Medical Research Council, Cape, South Africa.

Lysell [8] investigated 50 pairs of monozygotic twins and found no clear evidence of hereditary influence and said that it was impossible to identify a child's father from the rugae. Keil [9] reported that a higher degree of similarity exists in monozygotic than in dizygotic twins and that the rugae may be useful in a multivariate discriminant analysis for proving paternity. Finally, Bamberadeniya [10] subjected five families, including two sets of twins, to ruga pattern comparison and came to the conclusion that there is no evidence that ruga features are inherited.

In this project we have repeated an investigation of the palatal rugae in families and, using modern statistical techniques, have tried to establish a genetic relationship between the rugae of children and both their parents, their fathers, and their siblings.

Materials and Methods

The sample consisted of 17 white families including 34 parents and 49 children (Table 1), the number of children per family ranging from 4 (4 families), 3 (8 families), 2 (4 families), to 1 (1 family).

Palatal casts were made from alginate impressions and observation was carried out under stereomicroscopy and strong unilateral spotlighting. The classification, observation, and recording procedures of Thomas and Kotze [3–5] were applied, and the data used to construct a statistical analysis system (SAS) cluster map of cases (Fig. 1).

The cluster map is a device that sets out on xy coordinates the total of 83 individuals or levels of clustering on the x axis with each individual identifiable by family, age, and sex on the y axis. Cases are considered related when they group together (Fig. 1), and an ideal result would have been an entire family or at least father and children all clustering at Level 83. The reality was however somewhat different.

Results

The first and best cluster occurred on Level 82 and was between the ten-year-old boy of Family 7 and the eleven-year-old girl of Family 3. The next occurred on Level 81, the next on Level 80, and so on. All were pairs until the first triple cluster on Level 73 was encountered and the first quadruple cluster on Level 59 (Fig. 1).

The clusters increased in size down the levels until three large clusters existed on Level 3, two on Level 2, and one on Level 1. Table 2 summarizes the clustering between parents and all children, best child and best parent (that is, whichever parent and child cluster at the highest level), and all the children.

Discussion

At the outset it must emphasized that this analysis has been carried out on the face value of the data only and that the genetic implications have not been considered. This is necessary if the procedure is to remain practical.

TABLE 1—*Details of the sample of 17 families.*

		Sex		Age			
	n	M	F	Min	Max	$\bar{X}$	SD
Parents	34	17	17	35	58	43.40	5.26
Children	49	30	19	5	21	13.10	4.30
Total	83	47	36	...	...	...	...

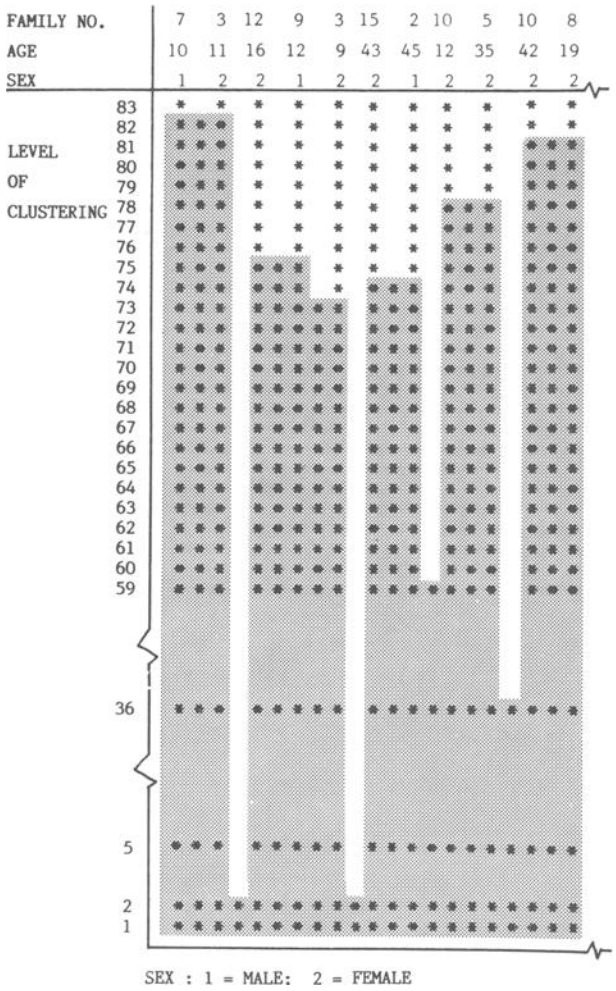

FIG. 1—*The abbreviated SAS cluster map which includes the age, sex, and family affiliation of 83 members from 17 families on the* y *axis and 83 levels of clustering on the* x *axis.*

The cluster map, to have been at all useful in paternity determination, should have shown each father clustering with all his children at Level 83. As it turned out, however, the best clustering between father and all his children occurred four times on Level 5, one of which included the mother (Table 2).

The clustering improved considerably however when only the best clustering child was matched with the best clustering parent of each family. The highest level found for this combination was 53, followed by 37, then 19, and downwards.

The clustering of all the children in one family with each other is reflected in the last column of Table 2 and revealed that Levels 29 and 15 were the best that could be achieved. It was a clear and perhaps an expected occurrence that the smaller the family, that is, two children, the better they clustered together.

A condensation of the data (Table 3) showed that the fathers clustered slightly better than the mothers, but that the difference was small and insignificant.

TABLE 2—*A summary of the important clustering levels of the 17 families.*

		All Children to Best Parent		Best Child to Best Parent		Children to Each Other
Family	No. of Members	Parent	Level	Parent	Level	Level
1	5		1	M	12	1
2	5		1	FM	2	1
3	6	F	5	F	19	5
4	5		1		1	4
5	5		1	F	4	1
6	5		1	M	53	1
7	5		1	FM	14	1
8	4	M	2	M	7	2
9	5		1	F	11	1
10	5	FM	2	M	37	2
11	6		1	M	13	1
12	4	F	5	F	5	29
13	6		1	F	6	1
14	6		1	FM	2	1
15	3	M	2		...	...
16	4	FM	5	FM	7	5
17	4	F	5	F	5	15

TABLE 3—*The percentage frequency of clustering between fathers and mothers and children regardless of level.*

	All Children to Best Parent, %	Best Child to Best Parent, %
Father	56	53
Mother	44	47

Conclusion

It can thus be concluded that the palatal rugae cannot be used in a practical procedure to determine paternity. Considering the polygenic nature of the inheritance of these structures, the pattern can never predictably contain characteristics that appear in both generations. This is a further confirmation of the closely equivalent natures of dermatoglyphs and palatal rugae.

References

[1] Race, P. R. and Sanger, R., "The Inheritance of Blood Groups," *British Medical Bulletin*, Vol. 15, No. 2, 1959, pp. 99-108.

[2] Holt, S., "Dermatoglyphic Patterns," in *Genetical Variations in Human Populations*, Pergamon Press, New York, 1961.

[3] Thomas, C. J. and Kotze, T. J. v.W., "The Palatal Ruga Pattern: A New Classification," *Journal of the Dental Association of South Africa*, Vol. 38, No. 3, March 1983, pp. 153-157.

[4] Thomas C. J. and Kotze, T. J. v. W., "The Palatal Ruga Pattern in Six Southern African Human Populations, Part I: A Description of the Populations and a Method for its Investigation," *Journal of the Dental Association of South Africa*, Vol. 38, No. 9, Sept. 1983, pp. 547-553.

[5] Thomas, C. J. and Kotze, T. J. v. W., "The Palatal Ruga Pattern in Six Southern African Human Populations, Part II: Inter-racial Differences," *Journal of the Dental Association of South Africa*, Vol. 38, No. 3, March 1983, pp. 166-172.

[6] Thomas, C. J. and Kotze, T. J. v. W., "The Palatal Ruga Pattern in Six Southern African Human Populations, Part III: An Evolutionary Perspective," *Journal of the Dental Association of South Africa*, Vol. 38, No. 3, March 1983, pp. 173-176.

[7] Thomas, C. J. and Kotze, T. J. v.W., "The Palatal Rugae in Forensic Odonto-Stomatology," *Journal of Forensic Odonto-Stomatology*, Vol. 1, No. 1, Jan. 1983, pp. 11–18.
[8] Lysell, L., "Plicae Palatinae Transversae and Papilla Incisiva in Man: a Morphologic and Genetic Study," *Acta Odontologica Scandinavica*, Vol. 13, Suppl. 18, 1955.
[9] Keil, A., *Grundzüge der Odontologie*, Gebruder Borntraeger, Berlin, 1966, pp. 118–119.
[10] Bamberadeniya, K., "A Study of the Rugae Pattern and the Shape of the Incisive Papilla in a Sri Lankan Population," *Sri Lanka Dental Journal*, Vol. 9, 1978, pp. 11–23.

Address requests for reprints or additional information to
Professor C. J. Thomas
Faculty of Dentistry
University of Stellenbosch
Private Bag X1
Tygerberg, 7505, Cape, South Africa