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Comparison of Fingernail Ridge Patterns of Monozygotic Twins

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ABSTRACT: The ridge patterns on the fingernails of corresponding fingers of a pair of twins were compared microscopically and found to be readily distinguishable from one another. Based on blood grouping in six blood group systems (ABO, Rhesus, Ss, Duffy, Kidd, and Kell), the probability that the twins were monozygotic was calculated to be 89.1%.

KEYWORDS: forensic science, fingernails, human identification, fingernail ridge patterns, twins

Over the years there has been interest in the use of fingernail ridge patterns as a means of personal identification [1-9]. Such use requires that the fingernail ridge patterns appearing on a person's fingernails be unique. Both MacDonell and his colleagues [4-7] and Haag [9] have reported comparisons of the fingernail ridge patterns on the fingernails of monozygotic (identical) twins. In all of the reported twin studies, the fingernail ridge patterns on the corresponding fingers of each twin did not match. None of these studies offered any genetic evidence that the twins studied were in fact monozygotic. Haag relied upon the self-description of the twins he studied. Medical researchers have found a classification error of 2 to 5% when twins are asked to classify themselves [10]. MacDonell [5] also presented a variety of anthropometric measurements of one set of twins that he studied. While such measurements are highly suggestive that the twins studied were in fact monozygotic, most of these measurements do not lend themselves to a calculation of the probability that the twins were actually dizygotic. We present here the results of a study in which the fingernail ridge patterns of a pair of twins whose red blood cells had been grouped in six blood group systems were compared microscopically.

Materials and Methods

The subjects of this study were a pair of 48-year-old black, female twins (hereafter designated J. A. and J. D.), one of whom was hospitalized at Walter Reed Army Medical Center, Washington, DC. Full-width fingernail clippings were obtained from each finger of each twin using cosmetic fingernail clippers. Each clipping was initially taped to a labelled index card and placed in an envelope. Each clipping was subsequently mounted

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on a metal specimen stub and sputter-coated with an approximately 0.15-nm layer of gold and palladium using a Samsputter-2a sputter coater (Touimis Research Corp., Rockville, Maryland). Such coating renders the fingernail clippings opaque and facilitates their subsequent microscopic examination. The coated clippings were compared microscopically with an American Optical Corp. UFM-2 forensic microscope (Model K2031A) equipped with $\times 1.2$, $\times 2$, and $\times 4$ objectives and a fiber optic illuminator. Photomicrographs were made with Polaroid 665 positive/negative black-and-white film.

Blood samples were taken from each twin by medical personnel at Walter Reed Army Medical Center and typed in the ABO, Rhesus, Ss, Duffy, Kidd, and Kell blood group systems.

Results and Discussion

The results of the blood typing of the twins are given in Table 1. Each twin had the same blood type in each of the blood group systems. The probability that the twins were in fact dizygotic was calculated from these blood grouping results using the methods of Maynard-Smith and Penrose [11]. The result is shown in Table 2. The probability that the twins were in fact dizygotic was found to be 10.9%; therefore, the probability that the twins were monozygotic was 89.1%. In these probability calculations, the initial

TABLE 1—Blood grouping results for a pair of twins (J. A. and J. D.).

System	Twin	
	J. A.	J. D.
ABO	0	0
Rhesus	DCce ^a	DCce ^a
Ss	ss	ss
Duffy	Fy(a-b-)	Fy(a-b-)
Kidd	Jk(a+b+)	Jk(a+b+)
Kell	Kk	Kk

^aMost probable genotype R₁R₀.

TABLE 2—Probability of dizygosity based on genetic and other data.

Initial probability of dizygosity	2.459 ^a
Probability based on likeness of sex	0.500
Probability based on likeness of ABO type	0.733
Probability based on likeness of Rhesus type	0.637
Probability based on likeness of Ss type	0.853
Probability based on likeness of Duffy type	0.826
Probability based on likeness of Kidd type	0.602
Probability based on likeness of Kell type	0.503
Total relative probability of dizygosity, pD	0.122
Total probability of dizygosity, $pD/(1 + pD)$	0.109

^aBased on a frequency of 71.092% for black dizygotic twins [12].

probability of dizygosity was based on a rate of dizygotic twins in the U.S. black population of 71.092% [12]. Gene frequencies for the U.S. black population published by the American Association of Blood Banks [13] were used in the remaining calculations.

The fingernail ridge patterns on the corresponding fingers of this pair of twins did not match when they were compared microscopically. Figures 1 through 3 show photomicrographs of the fingernail clippings from the left index, left ring, and right middle fingers, respectively. Clearly, these ridge patterns are readily distinguishable from one another. These results give further indication that fingernail ridge patterns are unique and consequently may be used for personal identification.

Summary

The ridge patterns appearing on the fingernails of a pair of twins were compared microscopically and found to be readily distinguishable. Based on blood grouping in six blood group systems (ABO, Rhesus, Ss, Duffy, Kidd, and Kell), the probability that the twins were monozygotic was calculated to be 89.1%.

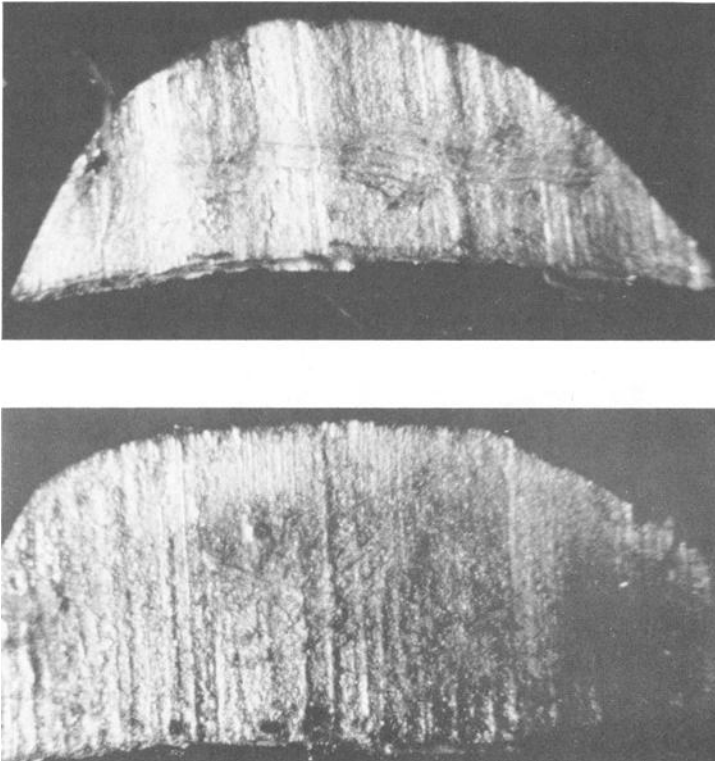


FIG. 1—Photomicrographs of fingernail clippings from left index fingers of twins J. A. (upper) and J. D. (lower).

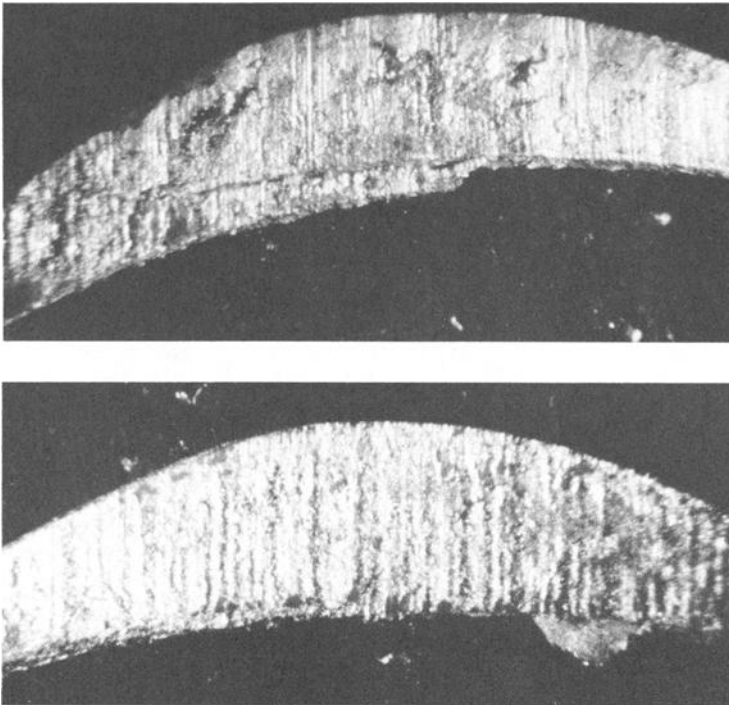


FIG. 2—Photomicrographs of fingernail clippings from left ring fingers of twins J. A. (upper) and J. D. (lower).

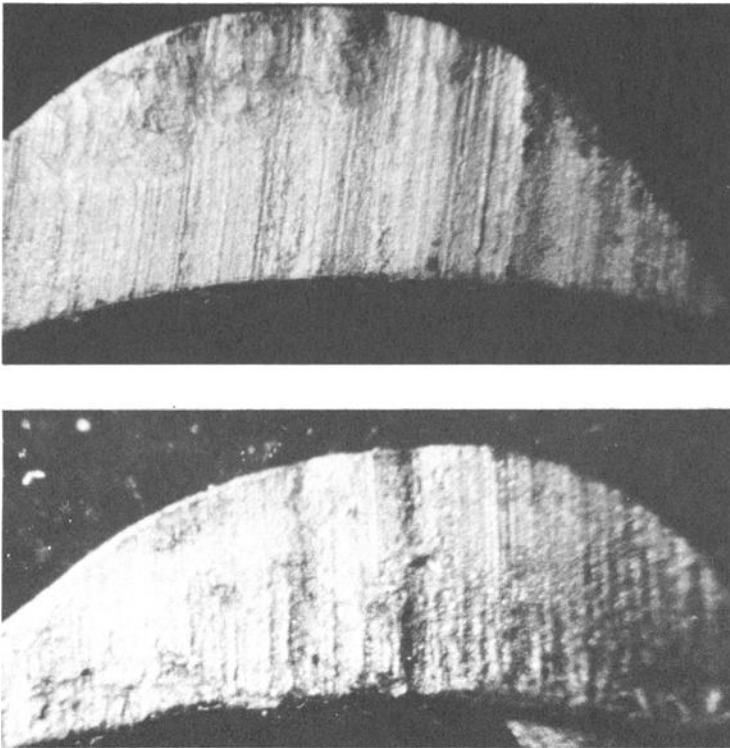


FIG. 3—Photomicrographs of fingernail clippings from right middle fingers of twins J. A. (upper) and J. D. (lower).

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