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Hypodontia: Genotype or Environment? A Case Report of Monozygotic Twins

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Abstract: *A case report is presented of monozygotic twins with variable expression of hypodontia. DNA fingerprinting was used to confirm monozygosity, and this evidence supports the theory that genetic coding is not the sole controlling factor in tooth agenesis. It is suggested that DNA fingerprinting should be considered the gold standard for determination of monozygosity.*

Index words: DNA Fingerprinting, Hypodontia, Monozygotic Twins

Introduction

Hypodontia is defined as the developmental absence of one or more teeth. The incidence of hypodontia varies; Brown (1957) reported 4·3 per cent, Grahnen (1956) found 6·1 per cent of Swedish schoolchildren affected, and in a sample of 6000 consecutively referred orthodontic patients Rose (1966) reported 4·3 per cent affected.

The aetiology of hypodontia generates much debate. Genetic coding plays a major role in development of hypodontia which can associate with many syndromes (Laatikainen and Ranta, 1994; Welbury *et al*., 1987). However, the influence of environmental factors is controversial (Graber, 1978; Markovic, 1992).

In a sample of 1115 school children Brook (1984) showed hypodontia and microdontia were more commonly associated, as were hyperdontia and macrodontia. He suggested a multifactorial aetiology of hypodontia, combining polygenic and environmental influences. Suarez and Spence (1974) support the polygenic model.

Monozygotic twins with variable hypodontia have been described (Gravely and Johnson, 1970; Nik-Hussein and Salcedo, 1987; Sperber *et al*., 1994), as have monozygotic triplets with discordance for hypodontia (Markovic and Trisovic, 1979; Möller *et al*., 1981). One problem with the early studies, is that monozygosity was not established absolutely, although Sperber *et al*. (1994) did use DNA analysis. A recent advance in genetic research has been the development of 'DNA fingerprinting' which can confirm or refute monozygosity (Jeffreys *et al*., 1985).

Case Report

Identical twins were examined at age 12 years 5 months, both had crowding and one had a significantly increased overjet. There was no history of digit sucking or previous extractions.

Twin A (Fig. 1) exhibited slightly narrower facial features than twin B (Fig. 2), and their lateral cephalograms demonstrate the difference in the overjet (Figs 3 and 4). Cephalometric tracings have been superimposed and shown in Fig. 5. Both twins were missing 15, 31, 41, 45; twin A in addition had 25 absent; twin B also had 48 missing and 55, 85 retained. The orthopantomograms are shown in Figs 6 and 7.

DNA Fingerprinting

In view of the twins' slight differences in facial appearance and extent of hypodontia, it was desirable to establish monozygosity. Deoxyribonucleic acid (DNA) was extracted from blood samples, digested and prepared according to the method of Hernandez *et al*. (1993) to produce DNA fingerprints. Membranes were hybridized with multilocus probes 33·6 and 33·15 (NICE® Cellmark Diagnostics) and subsequently hybridized with a cocktail of 4 single locus probes (NICE® MS31, MS43, G3 and MS205, Cellmark Diagnostics, Giles *et al*., 1990). Autography was carried out at 30°C using Hyperfilm (Amersham International plc, Amersham Place, Little Chalfont, Buckinghamshire, HP7 9NA.).

The DNA fingerprints (Fig. 8) and DNA profiles produced from blood samples of twins A and B were identical, indicating that they are monozygotic.

Note

The multilocus probes discovered by Professor Alec Jeffreys are claimed in UK Patent No 2166445 and corresponding world-wide patent applications. The single locus probes discovered by Professor Alec Jeffreys are claimed in UK Patent No 2188323 and corresponding world-wide patent applications.

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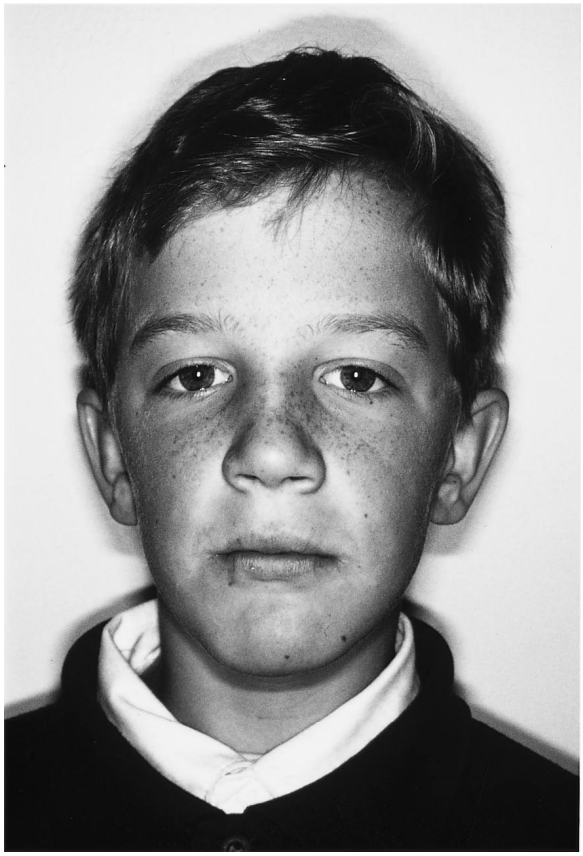

FIG. 1 Twin A facial appearance.

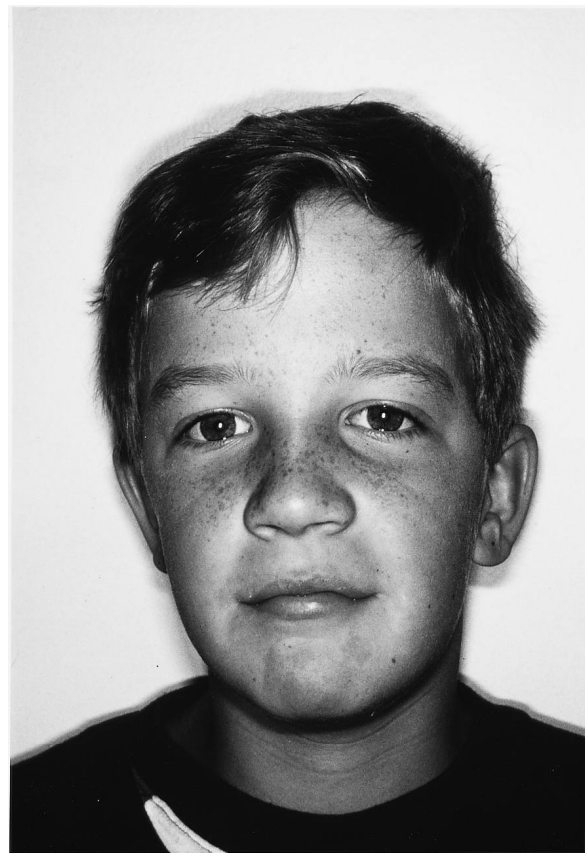

FIG. 2 Twin B facial appearance.

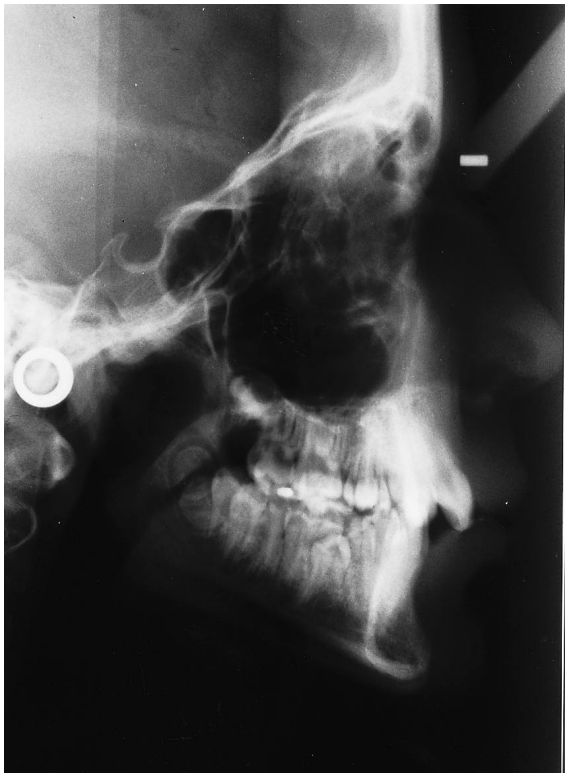

FIG. 3 Twin A lateral cephalogram.

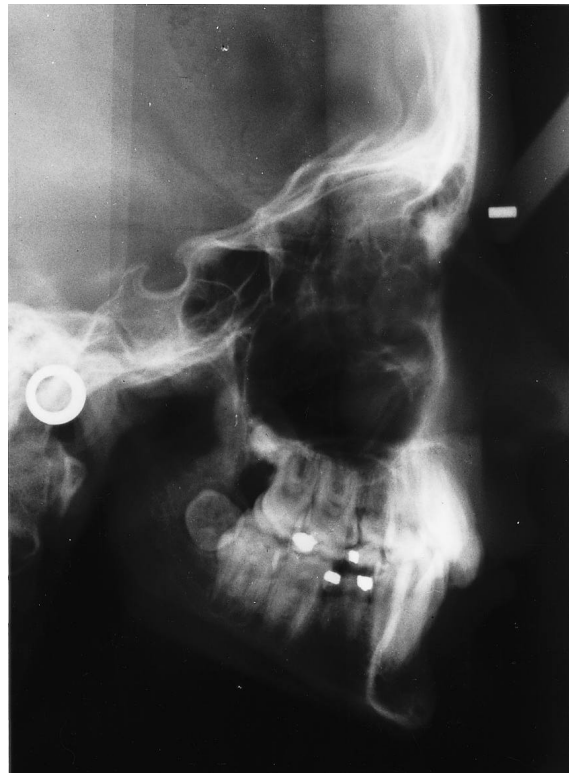

FIG. 4 Twin B lateral cephalogram.

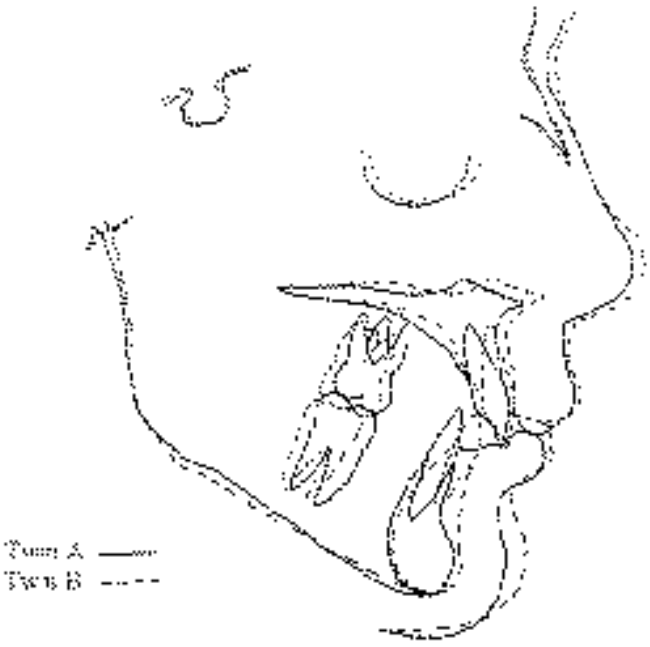

FIG. 5 Superimposition of lateral cephalogram tracings, on sella–nasion at sella.

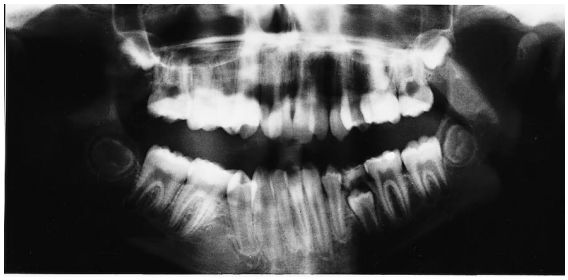

FIG. 6 Twin A orthopantomogram.

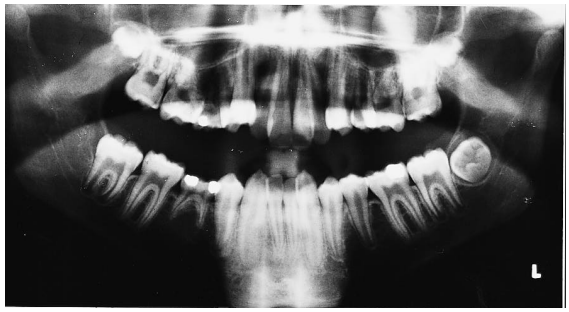

FIG. 7 Twin B orthopantomogram.

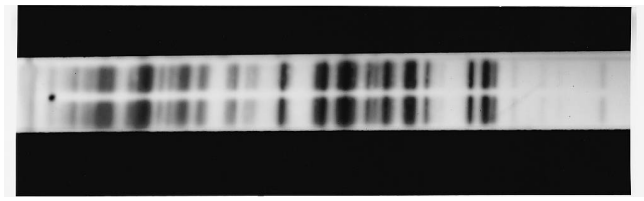

FIG. 8 Identical DNA fingerprints for twins A and B, using the multilocus probe 33·6. (NICE® Cellmark Diagnostics).

Discussion

The variable expression of hypodontia in monozygotic twins has previously been reported (Gravely and Johnson, 1970; Boruchov and Green, 1971; Nik-Hussein and Salcedo, 1987; Sperber *et al*., 1994), and this case report would support that evidence. However, DNA fingerprinting now allows the diagnosis of monozygosity to be confirmed with certainty (Jeffreys *et al*., 1985). Becker (1979, 1985) has criticized several authors for assumptions of monozygosity made on the basis of inadequate blood tests or merely on similarities in appearance. DNA fingerprinting should now be considered the gold standard in establishing monozygosity.

Willmot (1984) described monozygotic twins with dental differences similar to those described in this report. One twin in Willmot's paper was a thumbsucker, and it is interesting to see in this paper an increased overjet in one twin, in the absence of a digit-sucking habit.

Boruchov and Green (1971) showed that 55 per cent of monozygotic twins are discordant for hypodontia. Markovic (1992) showed concordance for the absence of permanent lateral incisors in six pairs of monozygotic twins and suggested this was highly indicative of a dominant genetic aetiology of hypodontia and/or hypoplasia of lateral incisors. However, Townsend *et al*. (1995) displayed discordance for agenesis of permanent maxillary lateral incisors in five pairs of monozygotic twins, and suggested a possible link with disparate birthweights of the twins.

The international 'Human Genome Project' aims to map 50,000 functional genes. In 1992, 5100 had already been mapped including 464 abnormal genes (Markovic, 1992). In searching for genetic markers of hypodontia Arte *et al*. (1996) excluded several genes coding for growth factors, and Niemenen *et al*. (1995) excluded the homeobox genes, MSX1 and MSX2. The specific markers for hypodontia remain unknown.

Summary

A case report has been presented of a pair of monozygous twins with variable expression of hypodontia. DNA fingerprinting has allowed the diagnosis of monozygosity to be firmly established. This test should become the benchmark for future studies of monozygous twins.

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