Dental maturity in children with Dystrophic Epidermolysis Bullosa

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Abstract

Purpose: This study was performed to compare Dental Age (DA) of children with Dystrophic Epidermolysis Bullosa recessiva (DEBr) with the DA of healthy children.

Methods: Orthopantomographs (OPG's) of children with DEBr were compared with those of healthy children. Dental maturity was estimated using Dermirjian's method. A total of 48 pairs of OPG's were compared.

Results: There was a considerable range of variation in the difference between the chronological age and the dental age of both groups. This varied from minus 2 years 8 months to plus 3 years for the control children and minus 3 years 1 month to plus 3 years 4 months for the DEBr children. Despite this wider range the average DA of children with DEBr was statistically significantly delayed by 2 years 3 months.

Conclusions: The delay in dental developmental of children with DEBr may have an impact on the clinical management of these children. (Pediatr Dent 22:385-388 , 2000)

Dystrophic Epidermolysis Bullosa recessiva (DEBr) is a hereditary, chronic, skin disease. The autosomal recessive form is the most severe and is characterised by widespread bullae involving the skin and mucosal surfaces. These bullae frequently heal with severe scarring and contracture. (Fig 1) As a result, tongue atrophy, microstomia, and ankyloglossia occur.[1] Even food of normal consistency can cause severe oropharyngeal mechano-bullous ulceration in DEBr. As a consequence, these children frequently suffer severe restriction of nutrient intake and unless a feeding gastrostomy is placed well before puberty,[2] height and weight are severely reduced. Without such intervention, those who survive into adult life suffer from cachexia and have delayed skeletal and sexual maturation.[3] The presence of delayed dental age in individuals with growth failure and delayed sexual maturation has been reported.[4,5] Although delayed dental age is recognised, it has not previously been quantified in children with DEBr.

Dental maturity should be considered along with skeletal development and stature as a major component of development.[6] Knowledge of dental age is useful to the orthodontist, paediatric dentist, pediatrician, and to the pediatric endocrinologist in order to plan and evaluate treatment.[7] In addition, it provides important information for the forensic odontologist,[8] the anthropologist[9] and archaeologist.[10]

The aim of this study was to estimate dental age in a group of children with DEBr and compare it with the dental age of healthy children.

Methods

The study was approved by the Research Ethics Committee of The Great Ormond Street Hospital for Children. The sample consisted of 48 Orthopantomographs (OPG's) of children with DEBr aged between 4 years 1 month and 18 years 7 months. The radiographs have been collected over a five-year period as part of their on-going clinical care at Great Ormond Street Hospital for Children. All OPG's were taken before any of the children were provided with a feeding gastrostomy. The control group comprised 48 OPG's of healthy children aged between 4 years 1 month and 18 years 4 months, who attended the Department of Pediatric Dentistry at the Eastman Dental Hospital. The control group was matched as closely as possible for chronological age and gender. This was achieved by matching radiographs within three months (plus or minus) of the age of the DEBr child. Each group consisted of 26 males and 22 females. Of these, 37 were Caucasian and 11 were

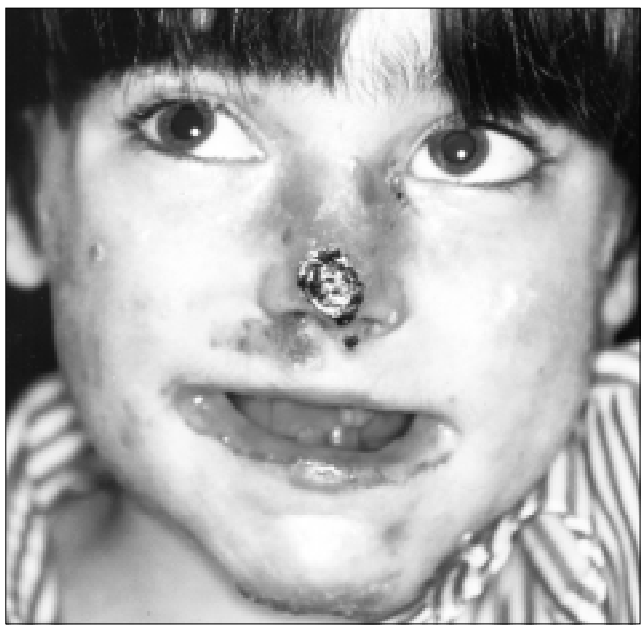

Fig 1. A boy aged 8 years with Dystrophic Epidermolysis Bullosa.

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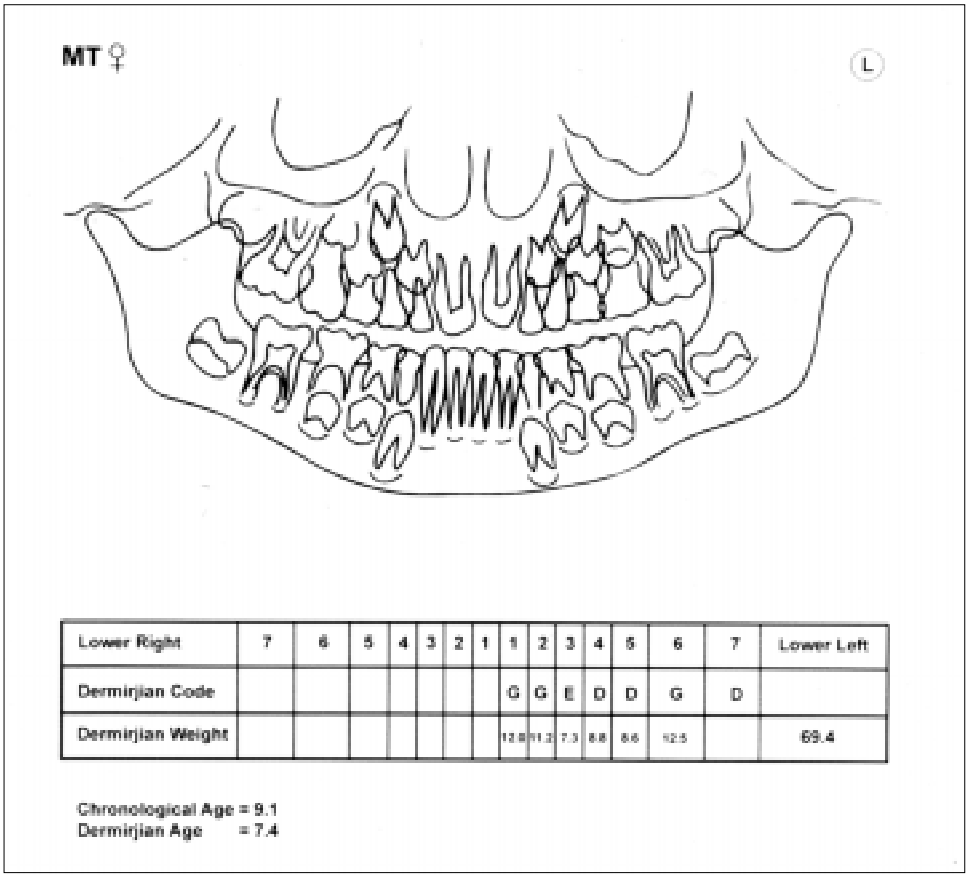

Fig 2. Schematic diagram illustrating Demrijian's method of dental age assessment.

Asian. Assessment of all radiographs was carried out by one examiner (AK).

The Demirjian method[7,11] (Fig 2) was used to assess the dental age of the patients from the radiographs (Fig3). This system uses weighted scores of each of the seven mandibular teeth on the left side. The third molar is not included. For each tooth, the eight stages of development, from calcification of the tip of the cusp to the closure of the apex, are designated with letters A to H. The same letter rating for different teeth receives a different weighted score. The weighted score for each tooth is read from gender specific tables. All the individual tooth scores for one patient are added together, to give a total maturity score for each patient. This score is then converted to age using percentile charts. This provides the Demirjian Dental Age (DDA) for an individual patient. The dental age for each child was then compared to chronological age. A dental age greater than chronological age, indicates advanced maturity of the sample child against the French–Canadian standards.[6]

An important feature of Demirjian's system is that the ratings are assigned by an observer using a set of radiographic picture standards of each tooth type and a written description of the stages of dental formation, to which the pictures correspond. This simplifies the assessment of each tooth. If a tooth is absent the corresponding tooth on the contralateral side is used.

Calibration

Prior to commencing the study, one examiner (AK) undertook a period of training, using the bank of radiographs and the training program supplied on the Demirjian CD-ROM.[12]

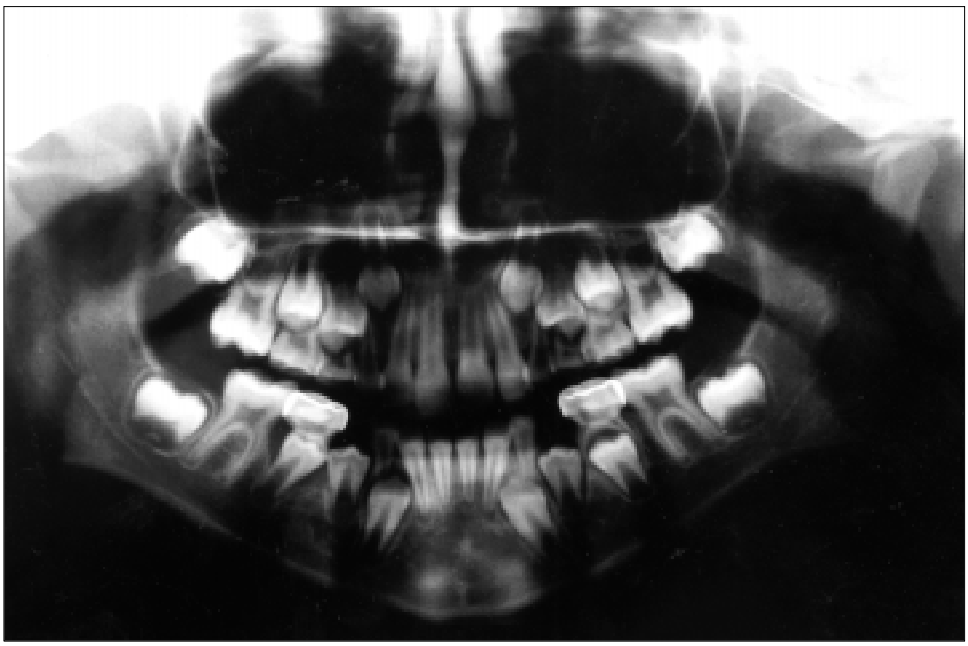

Fig 3. Orthopantomograph of a patient aged 7 years with Dystrophic Epidermolysis Bullosa.

Reproducibility

Intra-Rater Agreement: Ten radiographs of patients with DEBr were scored by one examiner (AK) one week apart using Demirjian's method. The identity of the radiographs was concealed at the time of assessment. The total maturity score for each patient was converted to DA using Demirjian's CD-Rom.[12] The outcome variable was DDA for each patient.

Inter-Rater Agreement: A random sample of ten radiographs was examined by a second experienced examiner (GJR) in order to assess inter-examiner reproducibility.

Main study: Forty-eight OPG radiographs of children with DEBr and 48 OPG radio-

Table 1. Summary of Data for Dystrophic Epidermolysis Bullosa Recessiva and Healthy Control Children

	Dystrophic Epidermolysis Bullosa Recessiva	Healthy Control Children
Number of OPG's	48	48
Males	26	26
Females	22	22
Caucasian	37	37
Asian	11	11
Chronological age	4.1 - 18.7 years	4.1 - 18.4 years
Mean chronological age	9.7 years	9.8 years
Dental age	4.5 - 15.4 years	4.4 - 15.4 years
Mean dental age	10.1 years	10.3 years

There were no significant differences when the data were subjected to Chi-square or student's t tests as appropriate.

graphs of healthy children were assessed. All radiographs were assessed by one examiner (AK). The name, gender, ethnicity, and date of birth were concealed at the time of viewing. After the assessment of each radiograph for both control and study groups, the outcome value for both groups was the total weighted score. The gender was specified and the DDA for each case was then provided for each subject using the computer programme on the Demirjian CD-Rom.

Results

The number of OPG's examined, chronological age, dental age gender, and ethnicity of both groups are shown in Table 1.The reproducibility of the Demirjian's method was assessed using the raw scores and paired t tests for the data from the study group.[13]

Intra-Rater Agreement: Six discrepancies were found at the second assessment. Thus, the percentage error was 9%. Between the two assessments, the discrepancy was never more than one stage up or down (Table 2).

Inter-Rater Agreement: Four discrepancies of dental age were found at the second assessment. Between the two assessments, there was no case where the discrepancy was more than one stage up or down. Cohen's Kappa was performed in order to measure the inter-rater agreement. This was 0.88, which is almost perfect agreement between the two examiners.

Study and control group

Data were assessed for normality using the Shapiro-Wilks test and found to be normally distributed, for Chronological age in control group and DEBr group respectively, P=0.2451 and P=0.1920; for DDA in the control group and DEBr group respectively P=0.8423 and P=0.2014. The data were normally distributed. For the categorical data (gender and ethnicity), a statistical test was not used as the two groups were perfectly matched.

A paired t test was performed to compare the chronological age between the study group and the control group. The results were not statistically significantly different (P=0.105). Thus the two groups were well matched for chronological age.

A paired t test was performed to compare the DDA between the control group and the DEBr group. The results (Table 2) were statistically significantly different (P=0.0398).

Discussion

A prerequisite to the use of the estimates of maturity is a system of scoring that is reproducible[14] and free of bias. In this investigation, Demirjian's method of scoring was subjected to repeat measurements on a representative proportion of the OPG's and it has been shown that the examiner (AK) was free of bias as the identity of the radiographs was hidden during assessment.

A disadvantage of the Demirjian method is that it requires some time consuming conversions to be carried out, for example, conversion of stages to maturity scores, sum of weighted scores, and conversion of the total maturity score to dental age, using special centile charts for males and females. These difficulties have been overcome by using the computer program supplied on the Demirjian CD-Rom.[12] It was found in practice to be very easy and straightforward to use, partly because of the facility for training at different levels of complexity and partly because of the computerized management of tooth assessments. Another disadvantage of the Dermirjian method is that the standards of development are based on French Canadian schoolchildren.[6] It is clear that these data cannot be directly extrapolated to other ethnic groups. Not withstanding this, the stages of development are directly applicable and provided the same method is used for both control and experimental subjects the differences obtained are suited to an appropriate statistical analysis such as was carried out in this study.

The amount of delay in the dental development of children with DEBr although statistically significant, is small (2 1/4 months). This is consistent with findings in children with cystic fibrosis,[15] leukemia,[16] medical indigence,[9] after total body irradiation in bone marrow transplant recipients[17] and in patients with chronic renal failure[15] who have a slight but non-significant delay in dental development. On the other hand, the stability of dental development and maturity is main-

Table 2. Comparison of Dermirjian Dental Age between DEBr Children and Healthy Control

	N	Mean Dental Age (years)	Standard Error	Standard Deviation	95% Confidence Interval
Control group dental age (years)	48	10.3	0.41	2.84	9.5 – 11.1
Study group dental age (years)	48	10.1	0.39	2.76	9.3 – 10.9
Difference		0.19	0.11	0.78	-0.03 – 0.41

P = 0.039 statistically significant.

tained when patients receive cytotoxic drug therapy.[16] Genetic factors, chronic malnutrition, delayed somatic and skeletal growth, and anomalies in tooth structure due to debilitating episodes during the dental development period, may contribute to the retarded dental development found in this study.

An unexpected finding was the very wide spread of DDA, although this was less than the spread of chronological age in both control and study groups (see Table 1). This is consistent with a previous study on dental developmental delay carried out on children with chronic renal failure.[15]

A weakness of data at the present investigation is the lack of any measurements of height, weight, or skeletal growth for an assessment of somatic or skeletal maturity. For ethical reasons, it would no longer be possible to obtain hand/wrist radiographs for research purposes. Although data regarding height, weight, and daily calorific intake were available for children with DEB from the Great Ormond Street Hospital and have already been published.[2] Similar data were not available for the control group derived from the Eastman Dental Hospital (EDH). This is because these records are not routinely kept in the EDH. As a result a wider overall assessment of skeletal maturity for both groups was not possible.

It is clear that given the very severe inhibition of growth seen in children with DEBr,[2] the dental delay was, on average, surprisingly small. A closer look at the data reveals that small mean difference in DDA masks a wide range of differences in both the DEBr and the control subjects. In the DEBr patients, this is a year or more in more than 25% of the DEBr children studied. The possible explanation for this is the evolutionary importance of the dentition, particularly in carnivorous mammals, as teeth are so necessary for survival in the wild state. Nature has provided for protection of growth of teeth from even extreme nutritional deficiencies as a means of ensuring survival.[19] The teeth present in DEBr are normal in appearance. Other forms of Epidermolysis Bullosa (e.g. Junctional) are often associated with a generalized defect of enamel such as Amelogenesis Imperfecta.[1]

The importance of the slight delay is difficult to assess. The wide variation seen even in this relatively small group indicates the need for clinicians to assess dental age prior to treatment. As indicated in the results, some DEBr patients were delayed by over 2 years. It is possible that such delay may influence root canal therapy in DEBr children with immature apices. More likely is the impact on serial extraction type orthodontic management. A full and detailed assessment of an OPG in such children will reveal the state of maturity of the dentition and thus be important in treatment planning.

Despite the clear statistically significant delay in growth of teeth, compared to the dramatic inhibition of height and weight the dental delay is surprisingly small.

Conclusions

The results of the present investigation indicate that children with DEB between 4 years 1 month and 18 years 7 months are dentally delayed, approximately 2 1/4 months compared with healthy children of the control group, when assessed using the Demirjian standards.

The dental delay of 2 1/4 months in children with DEBr is on average slight but statistically significant. The reported delay in dental formation supports the possibility of similar delay in eruption of teeth in patients with DEB and may be of importance in children where serial extractions are being considered.

The evaluation of dental age in children with DEBr may be of diagnostic value to the pediatric dental clinician, regarding endodontic procedures in oro-dental trauma.

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References

1. Eady RAJ: The classification of epidermolysis bullosa. In - A Comprehensive review of classification, management and laboratory studies DEBRA. GC Priestley, MJ Tidman, JB Weiss, RAJ Eady, Editors. London: 1990, pp 1-9.
2. Haynes L, Atherton DJ, Ade-Ajayi N, Wheeler RJ, Kiely EM: Gastrostomy and growth in dystrophic epidermolysis bullosa. Br J Dermatol 134:872-879, 1996.
3. Allman SA, Haynes L, MacKinnon P: Nutrition in Dystrophic Epidermolysis Bullosa. Paediatr Dermatol 9:231-238, 1992.
4. Garn SM, Lewis AB, Blizzard RM: Endocrine factors in dental development. J Dent Res 44:243-258, 1965.
5. Gleiser I, Hunt EE: The permanent mandibular first molar: Its calcification, eruption and decay. Am J Phys Anthropol 13:253-281, 1955.
6. Demirjian A: Dentition in Human Growth: A comprehensive treatise, 2nd ED. F Falkner, Tanner JM, Editors. New York: Plenum Press, 1986, pp 269-298.
7. Demirjian A, Goldstein H, Tanner JM: A new system of dental age assessment. Hum Biol 45:211-227, 1973.
8. Sopher IM: Forensic dentistry. Springfield: Charles C. Thomas, 1976, pp 113-124.
9. Rosen AA, Baumwel J: Chronological development of the dentition of medically indigent children: a new perspective. J Dent Child 48:437-442, 1981.
10. Liversidge HM: Dental maturation of 18th and 19th century British children using Demirjian's method. Int J Paediatr Dent 9:111-115, 1999.
11. Demirjian A, Goldstein H: New systems for dental maturity based on seven and four teeth. Ann Hum Biol 3:411-421, 1976.
12. Demirjian A: Dental development: CD-Rom University of Montreal,1993-94.
13. Bland JM, Altman DG: Statistical methods for assessing agreement between two methods of clinical measurement. Lancet 1(8476):307-310, 1986.
14. Houston WJB: The analysis of errors in orthodontic measurements. Am J Orthod 83:382-90, 1983.
15. Jaffe EC, Roberts GJ, Chantler C, Carter JE: Dental maturity in children with chronic renal failure assessed from dental panoramic tomographs. J Int Assoc Dent Child 20:54-58, 1990.
16. Primosch RE: Dental and skeletal maturation in patients with cystic fibrosis. J Oral Med 35:7-13, 1980.
17. Dahllof G, Nasman M, Borgstrom A, Modeer T: Effect of chemotherapy on dental maturity in children with hematological malignancies. Paediatr Dent 11(4):303-306, 1989.
18. Dahllof G, Barr M, Bolme P, Modeer T, Lonnqvist B, Ringden O, Heimdahl A: Disturbances in dental development after total body irradiation in bone marrow transplant recipients. Oral Surg. Oral Med. Oral Pathol. 65:41-44, 1988.
19. Pond CM: The significance of lactation in the evolution of mammals. 31:177–199,1977.