

Clinical and photographic assessment of erosion in 2-5-year-old children in Saudi Arabia

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Objective To compare findings from photographs of incisor teeth in pre-school children in Jeddah, Saudi Arabia to those on clinical examination for dental erosion. **Basic research design** Cross sectional study of 2-5-year-old Saudi Arabian children using two methods of examination. Measurement of erosion was carried out clinically using a scoring system and criteria based on those used in the United Kingdom national surveys. Photographs of labial and palatal surfaces of maxillary primary incisors were taken for each child and scored in the same way. **Setting** Kindergarten schools in Jeddah, Saudi Arabia. **Participants** 987 children from 17 randomly selected schools in Jeddah, Saudi Arabia. **Results** Readable photographs were available for 727 children. Two hundred and twenty (30%) had photographic evidence of tooth tissue loss. Prevalence estimates derived from clinical examination were higher than those for photographs (36% compared to 30%). Agreement was seen between the two methods for 93% of the surfaces included. **Conclusions** Photographs have been employed in research in dentistry as well as for documentation and illustration. In epidemiology they have proved to be valuable in measuring enamel defects but have not been used for other conditions. Photographs have potential in measuring erosion, but may benefit from refinement.

Key words: children, dental erosion, tooth wear

Introduction

Epidemiological measurement of erosion has relied heavily on subjective judgement of, for example, relatively minor degrees of loss of enamel surface contour, and has proved difficult in consequence. In previous studies, assessment has been through clinical examination alone.

Photographs have been used widely over the recent years in dentistry in clinical and epidemiological investigation as well as in documentation, illustration, and diagnosis in individual cases. In epidemiology, Nunn *et al.* (1992) compared findings using photographs to results derived from a clinical examination for enamel defects. The study showed that enamel defects could be more clearly seen in photographs, making them easier to study than within the constraints of a clinical examination. The accuracy of a clinical examination depends at least partly on factors such as examining conditions, examiner comfort (fatigue), co-operation of the subjects, quality of light and degree of reflection. Photographic examination produces a magnified view of the teeth. It may also be carried out with less fatigue and clearer vision. The method also allows use of a reference, since photographs are available for re-examination at any time.

Different types of photographic systems are available. In terms of the lighting methods, a ring flash is believed to provide the optimum illumination. Angulation is a second very important factor in giving a clear view of surface texture and reducing reflection (Levine *et al.*, 1989). Disadvantages of photographs lie in technical problems such as film damage, light reflection which often cannot be wholly eliminated, and dark or out of focus

pictures. To date, photographs have not been used in epidemiological studies of erosion, although in some reports photographs were used to evaluate or monitor progress of the condition in individual cases, and to serve as case records.

Method

This study formed part of a larger investigation of erosion in preschool children in Jeddah, Saudi Arabia. The sample included was drawn from 2-5-year-old children attending kindergarten schools in the city. Agreement for the study was obtained from the Ministry of Higher Education and President General for Girls Education Office in Saudi Arabia.

A total of 17 primary schools was randomly selected in each of the four geographic areas of the city (north, south, east and west). Letters were sent to parents requesting consent to their child being examined and photographed in schools. All children in selected schools were eligible to take part. Parents of 1,063 of the 1,554 eligible children (68%) gave consent.

Children were examined by one examiner (MAM) in a classroom at the school under standardised lighting conditions using a Daray light (Daray lighting Ltd). Each child was examined supine and data were recorded by a trained assistant. Clinical diagnosis was visual with a plane mouth mirror used to assist visibility and cotton rolls employed to remove any plaque or debris where necessary.

Examination for erosion was confined to primary maxillary incisors and used the scoring system that has

been described in more detail elsewhere (Al-Malik *et al.*, 2001). Wear for all surfaces was noted but, for the purposes of the study and as in previous surveys of erosion in primary teeth (Hinds and Gregory, 1995; O'Brien, 1994) only that affecting palatal and/or buccal surfaces was scored as erosion. Wear confined to incisal surfaces was excluded from the analysis.

Training and calibration exercises were conducted prior to the study. Repeat examinations of 30 children were made during the data collection to check intra-examiner reproducibility and yielded a kappa value of 0.92 for surfaces diagnosed as having erosion.

Following the clinical examination, photographs were taken of upper incisor teeth. Two photographs were exposed, one of the labial and one of the palatal surfaces of maxillary primary incisors for each child. Palatal views were taken using a polished steel photographic mirror (child size) (Rexodent Ltd, Southall, Middx, UK). The photographic equipment used was a Nikon F-601 camera with an Elicar 90 mm macro lens. This was used with a SUNPAK Auto DX12R Ring Flash at fixed power and with a T power source. Films were Kodachrome 64 KR 135-36 P films providing colour transparencies. Photographs were taken at a magnification of 1:1, and as close to a 30 degree angle from the labial surface as possible. Films were developed by Kodak Ltd (P.O Box 2, Deer Park Road, Wimbledon, London, SW19 3 UG). All clinical examinations and photography were carried out within the three month period between 1 September and 30 November 1998. Examination of transparencies was carried out by the same examiner (MAM) who was blind to results of clinical examination. Slides were projected using a Kodak projector and viewed in a darkened room using standardised conditions including a fixed projector/screen distance and the viewer seated at a single fixed point for all the readings.

Clinical and photographic data were analysed using the McNemar and chi square tests and kappa statistic was used to describe the extent of agreement between the two methods of assessment.

Results

Nine hundred and eighty-seven children aged 2-5 years were included in the study (out of the 1,063, the remaining 76 were either absent at all visits to the school or unable to co-operate sufficiently to take part) of whom 858 had photographs taken. Of the remainder, the parents of 52

did not consent to this part of the examination and 77 were not able to co-operate sufficiently. Forty-eight children allowed only one photograph to be taken but two were taken for each of the remaining 810 children.

Four films proved partly or wholly unsatisfactory with the result that one or both photographs proved to be of insufficient quality for 83 children. Results for photographic examination therefore relate to 727 children, each of whom had both labial and palatal views.

Results drawn from assessment of the photographs and from clinical examination for erosion in relation to child, tooth and tooth surface prevalence are summarised in Tables 1 and 2.

Of the 727 children included in the analysis of photographs, 220 (30%) had photographic evidence of tooth tissue loss affecting labial and/or palatal surfaces of one or more of their maxillary incisor teeth (Table 1). Scoring from photographs, 156 (71%) children were scored as having erosion confined to a score of 1 and 60 (27%) were scored as having evidence of erosion extending into dentine - score 2. Four children (2%) were seen to have erosion with a score of 3 involving pulp from the photographs.

Prevalence estimates derived from clinical examination for the same children were higher than those for photographs (36% compared to 30%). The difference was seen especially in prevalence of more extensive erosion extending into dentine (14% of children were thought to have erosion into dentine clinically compared to 8% on photographs). There was little difference in the prevalence of erosion confined to enamel and no difference in the very small number with erosion affecting pulp.

Of the 220 children diagnosed from photographs as having erosion 151 had central incisors affected, three had lateral incisors affected and in 66 cases erosion had affected both types of primary incisor. Estimates for central and lateral incisors alone were broadly similar to those from clinical examination where 155 had central incisors affected, four had lateral incisors affected but more (105), were diagnosed clinically as having erosion affecting both tooth types (Table 2).

In relation to surface type, 217 children had palatal erosion, three had erosion on both palatal and buccal surfaces and none had buccal erosion alone diagnosed from photographs. Clinically 258 of the same 727 children had been diagnosed as having palatal erosion, none had only buccal erosion and six were diagnosed as having both surface types affected (Table 2).

Table 1. Prevalence and severity of erosion measured from photographs and clinically for 727 children

	Number & (%) of children				
	With no erosion	With any erosion	Erosion confined to score 1	Erosion confined to score 2	Erosion confined to score 3
Photographic scores	507 (69.7)	220 (30.3)	156 (21.5)	60 (8.3)	4 (0.6)
Clinical scores	463 (63.7)	264 (36.3)	159 (21.9)	101 (13.9)	4 (0.6)

McNemar's test for differences in proportion with any erosion: ($\chi^2 = 20.07$, $df=1$, $P<0.001$)

Chi square test of frequency in relation to no erosion, erosion confined to score 1 and erosion with a score of 2 or more, ($\chi^2 = 11.97$, $df=2$, $P= 0.0025$)

Table 2. Prevalence of erosion in relation to tooth type and surface type affected measured from photographs and clinically for 727 children

	Number of children					
	Teeth affected			Surfaces affected		
	Central incisors only	Lateral incisors only	Both types of incisor	Palatal surfaces only	Buccal surfaces only	Both surface types
Photographic scores	151	3	66	217	0	3
Clinical scores	155	4	105	258	0	6

A total of 545 surfaces were diagnosed from photographs as showing erosion. 405 (74%) were scored as 1, 135 (25%) scored as 2 and 5 (1%) scored 3.

In the same children, 697 surfaces were scored clinically as having erosion, 449 (64%) as score 1, 241(35%) as score 2 and 7 (1%) as score 3.

Using photographs the mean number of teeth affected per child for children who had erosion was 2.41 (± 0.88) per child and the mean number of surfaces 2.42 (± 0.90) per child. This compared to values at clinical examination of mean numbers of teeth affected per child who had erosion of 2.71 (± 0.97) and mean number of surfaces of 2.73 (± 1.03) per child.

Estimates of prevalence alone may mask disagreement and analysis was also carried out in relation to individual subjects. Agreement was seen in a total of 598 cases (82%) agreement. There was in 439 cases as to no erosion being present (83% of the total scored as having no erosion), in 104 cases when it was confined to enamel (49% of the total who had values confined to score 1), in 51 cases when it was confined to dentine (46% of the total) and in four cases when it extended into the pulp (100%).

In 68 cases scored clinically as having erosion this was not detected photographically and in 24 cases the reverse was true. In 31 cases there was agreement that erosion was present but it was scored as confined to

enamel photographically and as extending into dentine clinically. In six cases a child was scored as having more severe erosion using photographs than clinically. The estimated kappa statistic for subjects was 0.64 when grading was included and, when considering if any erosion was present, it was 0.72. The level of agreement between clinical versus photographic scoring in terms of surfaces affected and erosion severity is shown in Table 3. When surfaces were directly compared, agreement was seen in 4,958 (93%) of the total of 5,322 surfaces. The estimated kappa value was 0.68.

Agreement was seen in 4,576 of surfaces as to no erosion being present (95%), in 265 when it was confined to enamel (45%), in 112 when it was confined to dentine (42%) and in five when it had extended to involve the pulp (100%).

Discussion

Photography has been thought to offer particular advantages in epidemiological research. In study of enamel defects for example, photographs may be easily selected, arranged and rearranged in random order making randomisation and blinding easier. They also allow for repeated assessment without the need to re-examine the subject. Photographs are easily transported and could also facilitate national and international comparisons using

Table 3. Tooth surface prevalence and severity of erosion in maxillary incisors teeth measured from photographs and clinically for 727 children

Photo scores	Number of tooth surfaces				Total
	No erosion	Erosion score 1	Erosion score 2	Erosion score 3	
No erosion	4,576	165	36	-	4,777
Erosion score 1	47	265	93	-	405
Erosion score 2	2	19	112	2	135
Erosion score 3	-	-	-	5	5
Total	4,625	449	241	7	5,322

kappa value=0.68

standardised measurements by one or several examiners. Results from a previous investigation suggested a good level of agreement between clinical and photographic assessment of erosion in exfoliated and extracted teeth (Al-Malik *et al.*, op.cit.). Results in this survey showed that the method was feasible and that it was acceptable to a large proportion of the young children included; it proved possible to take both labial and palatal views of a very high proportion (87%) of the young children who took part.

Although there were differences between the two methods in the extent to which erosion was detected, these were not great in real terms and closer inspection suggested a reasonable degree of comparability. Kappa values suggested a measure of agreement and in direct comparisons of scores at tooth surface level for example, agreement was seen in 93% of surfaces. Estimates of prevalence also showed a difference of only 6 percentage points. Photographs did therefore appear to be of value. However, there were technical difficulties, shown in the loss of four films, suggesting some disadvantage in the method. There was also evidence of some disagreement between the methods. Where differences did occur, these appeared to lie especially in distinguishing erosion involving dentine from that confined to enamel and to relate to cases where both lateral and central incisors were affected.

Difficulties in distinguishing severity of erosion may lie in the sharpness or contrast produced in images using a conventional camera set up and conditions less than the ideal of a photographic studio. Study of extracted and exfoliated teeth has demonstrated that both visual and photographic assessment may underestimate severity of tooth tissue loss (Al-Malik *et al.*, op.cit.).

In relation to teeth affected, although the proportions with only central incisors affected appeared similar, fewer cases were diagnosed using photographs in which both central and lateral incisors showed evidence of

erosion. This finding may simply have related to changes in judging severity in teeth adjacent to each other in the same mouth.

If the erosion in central incisors was more severe, and judgement of this level was altered in the case of photographs, then this reduced the likelihood of diagnosing erosion in lateral incisors in the same child. It could be seen that lateral incisors were very seldom scored as one or more in the absence of similar or higher scores in the adjacent central incisors. In all cases where lateral incisors alone were scored as having erosion, the adjacent central incisors were missing or carious.

In addition, in 48 out of 60 cases where scores for central incisors were lower on photographs than clinically, all scores for the adjacent laterals were reduced to zero and in a further five it was reduced from a maximum of 2 to 1. In only seven cases did it stay the same.

The amount of agreement seen and the extent to which photography proved feasible would seem to confirm that the method has potential in developing national and international comparisons in measuring erosion. However, there was disagreement and the method may well benefit from refinement. More sophisticated imaging techniques, such as through the use of digital cameras, but also more robust systems for use in surveys and use of computer enhancement methods would seem to merit further investigation towards this end. This study was confined to incisor teeth. It would also be of value to validate photographic findings against those from clinical examination of the dentition as a whole.

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