Community Dent Oral Epidemiol 2005; 33: 438–46

COMMUNITY DENTISTRY AND ORAL EPIDEMIOLOGY

Photographs as a means of assessing developmental defects of enamel

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Wong HM, McGrath C, Lo ECM, King NM. Photographs as a means of assessing developmental defects of enamel. Community Dent Oral Epidemiol 2005; 33: 438–46. © Blackwell Munksgaard, 2005

Abstract – *Objectives:* To evaluate the validity and reliability of photographic examinations for developmental defects of enamel (DDE) in maxillary and mandibular incisors and canines using a standardized process. *Methods:* The anterior teeth of 257 children were examined 'wet', both clinically and photographically for DDE, using the modified Federation Dentaire Internationale (FDI) (DDE) Index. A series of five standardized photographs were taken for each child: a frontal view perpendicular to the four incisors; two lateral views, each showing the lateral incisors and canines on each side of the dental arch; and the superior and inferior views, retaking of the frontal view with the camera held at approximately 30° above and below the horizontal plane. The photographs taken for each child were viewed as three different sets; the 'five-view' (frontal, two lateral views plus superior and inferior views), 'three-view' (frontal and two lateral views), and 'one-view' (frontal view only) slide sets. *Results:* Using 'one view' slides, 91.7% of teeth could be examined photographically. Whereas using multiple views 99.9% of teeth could be assessed. At the subject level, agreements between clinical diagnoses (gold standard) and photographic examinations were substantial to almost perfect ($k = 0.73$–0.86). At the tooth level, agreement was best for incisors ($k = 0.71$ or higher). The intra-examiner reproducibility was high for the photographic assessments at both subject and tooth levels ($k = 0.71$–0.95). *Conclusions:* Multiple-view photographic slides of 'five-view' and 'three-view' are valid and reliable for assessing DDE on the 12 anterior teeth, while a 'one-view' (frontal) was acceptable to study only the incisors.

Key words: developmental effects; enamel defects; photographic assessments

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Submitted 26 August 2004;
accepted 1 June 2005

The study of developmental defects of enamel (DDE) is a long-standing area of research that is of significant public health interest (1). Numerous epidemiological indices have been developed with which to assess the prevalence and extent of enamel defects (including fluorosis) (2). For the most part, studies of enamel defects have relied on clinical observations employing direct visual and tactile examinations. However, there are numerous concerns and limitations of using the clinical examination method. For instance, the clinical examination method has been criticized for permitting the introduction of unintentional observer bias and subjectivity, particularly when the issue is a sensitive and emotive one, as is water fluoridation (3, 4). In addition, there are concerns about the appropriateness of comparing clinical examinations conducted by different examiners in multicentre cross sectional studies or when monitoring changes in prevalence of enamel defects with time (5, 6). Furthermore, as the clinical examination method requires subject participation for a considerable time period it can be difficult to employ more than two different epidemiological indices and compare such findings (7).

The uses of photographic slides to simulate a clinical examination when assessing enamel defects has been suggested for some time now (8). Colour transparencies of tooth surfaces seem to offer several advantages over the clinical examination

method for the detection of enamel defect in terms of randomness, objectivity, remote examinations, subject and examiner comfort, permanent records for future comparisons, and the application of different approaches in the utilization of the same materials (9, 10).

However, there are some unresolved technical difficulties with the photographic assessment of enamel defects; for example, only the anterior teeth can be photographed easily (11). This may not be a major problem because these teeth have the greatest impact on aesthetics (12). Another issue is the teeth at the sides of the field of view, such as the lateral incisors and canines, are invariably rotated or overlapped in the photographic slide because of the arrangement of teeth in the dental arches. It has been suggested that multiple lateral view photographs can assist in overcoming this predicament (13). In addition, there is the problem of 'burn-out' caused by the flash of the camera and reflections of light which obscures part of a tooth surface when viewed on a photographic slide. Multiple photographs taken from positions superior and inferior to the horizontal plane at varying degrees can help in minimizing 'burn-out' (14–16).

Therefore, multiple photographs of different views may be necessary to record the information required for an assessment of DDE. However, there is a dearth of information about the validity and reliability of photographic methodology employed and/or the assessment techniques employed. Thus, the aim of this study to evaluate the validity and reliability of 'one-view' (frontal-view), 'three-view' (frontal-view and, left and right lateral views), and 'five-view' (frontal-view, left and right lateral views, and superior and inferior views) photographic slide sets, as a means to record DDE, on anterior teeth by comparing clinical and photographic examinations for the same group of subjects employing a standardized photographic technique.

Materials and methods

Sample

The study was conducted on a convenient sample of 257 school children who had been involved in a longitudinal study to establish a daily tooth brushing exercise using fluoridated toothpaste in kindergartens in Conghua, China (17). Approval to conduct this study was received from the Ethics Committee, Faculty of Dentistry, the University of Hong Kong. Prior to the examination, consent letters were sent to the parents of the selected children via the school staff. Participation was strictly voluntary; however, no refusals were encountered.

Clinical examinations

The clinical examinations of this study were carried out in the six primary schools in Conghua, and each selected child was examined in a supine position on a table. Before the examination, each anterior tooth of the children was cleaned with a gauze in order to remove any gross plaque or food deposits that were present. The teeth were examined 'wet' using a portable fibre-optic light, mouth mirror and sickle probe.

The diagnostic criteria were based on the modified FDI (DDE) Index for use in general purpose epidemiological studies which recognized three main types of enamel detects, namely, demarcated opacities, diffuse opacities and hypoplasia (18). The demarcated opacities included the white/cream and the yellow/brown subtypes. Under the main type of diffuse opacities, there were subtypes of diffuse lines/patchy, diffuse confluent, confluent/patchy plus staining and/or loss of enamel. Hypoplasia included subtypes of pits and missing enamel. Provision for recording the various combinations of the main types of DDE and the extent of DDE, as recommended for use with the FDI (DDE) Index, were adopted in this study. The recording of the extent of a surface area covered by enamel defects included normal, less than one-third, at least one-third to two-third, and at least two-third (18). A single defect <1 mm in diameter was not recorded (19, 20). A tooth was not examined for DDE if less than one-third of the tooth surface was visible. The reason for excluding the tooth was also recorded.

The type and extent of DDE were diagnosed by consensus of two trained and calibrated examiners. The levels of inter-examiner agreement for the diagnoses of the various subtypes of DDE for each anterior tooth using clinical photographs were substantial to almost perfect (kappa value = 0.78–0.96). During the clinical examination, a random sample of approximately 12% ($n = 31$) of the children were re-examined to monitor intra-examiner reproducibility.

Photographic examinations

Immediately after the clinical examination, the child sat upright on a straight backed chair and asked to look directly forward so that the ala-tragal

plane was approximately parallel to the floor. A pair of photographic retractors were then inserted into the child's mouth with the teeth slightly apart. The photographic slides of the child's twelve permanent anterior teeth were taken at 1 : 1/2 magnification using a Nikon F2 camera fitted with a Medical-NIKKOR 120 mm lens which had a built-in ring flash. The flash was tested prior to the study to ensure consistency of light output. The Medical-NIKKOR 120 mm lens is a fixed barrel lens. Once the aperture of magnification is set and clicked into place the length of the barrel does not change when the lens tilts forward. Hence, the distance from the focal plane of the camera to the teeth was standardized when the teeth were in focus. Kodak Ektachrome 100 PLUS Professional Film was used for the transparencies.

A series of five photographs were taken for each child, as shown in Fig. 1: a frontal view perpendicular to the four incisors; two lateral views, each showing the lateral incisors and canines on each side of the arch; the superior view, retaking of the frontal view with the camera held at approximately 30° above the horizontal plane; and the inferior view, retaking of the frontal view with the camera held at about 30° below the horizontal plane.

All of the exposed films were collected together and then sent for batch developing by a commercial photographic laboratory in Hong Kong. Three months after the clinical examinations the transparencies were coded randomly for identification, projected onto white screens using Kodak Ektapro 5000 slide projectors (Eastman Kodak Company, Rochester, NY, USA) and viewed at ×20 magnification at a distance of approximately 5 m in a darkened room. These developed photographic slides were projected as three separate sets. The first set, the 'five-view' slide set, was a composite series of five slides including the frontal, two lateral, the superior and the inferior views which were projected simultaneously. The second set, the 'three-view' slide set, was a composite series of three slides including the frontal and two lateral views which were projected simultaneously. The third set, the 'one-view' slide set, was only the frontal view of the teeth. Approximately 12% (31 × 3 sets) of the slides were repeated and coded randomly in each slide set to monitor intra-examiner reproducibility. Initially, 70 of the 'five-view' slide sets (slide sets numbers 1–70) were shown followed by 70 of the 'three-view' slide sets (slide sets numbers 71–140) and 70 of the 'one-view' slide sets (slide sets numbers 141–210). This

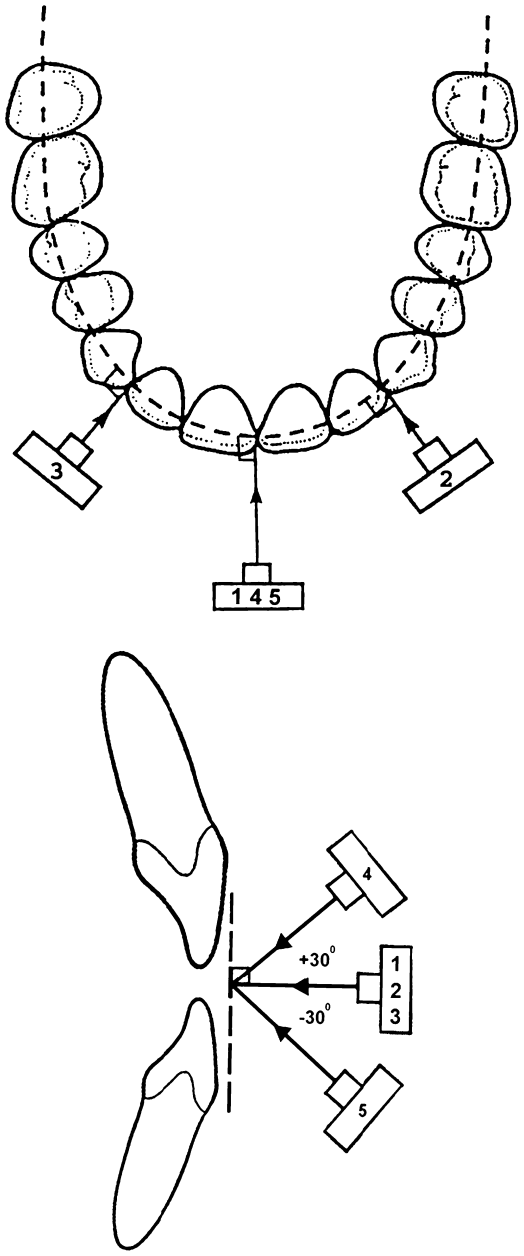

Fig. 1. A schema to show the position of the camera at which the frontal, two lateral, superior and inferior views were taken. The positions of the camera were: 1, the frontal view; 2, the right lateral view; 3, the left lateral view; 4, the superior view; 5, the inferior view.

procedure was adopted for the projecting of the slides to one of the examiners involved in the clinical examinations, until all of the slides in the three slide sets had been examined. The examiner was allowed to study each set of the slides for up to 60 s. The diagnostic criteria for DDE were the same as used in the clinical examinations of the study. A single defect, <1 mm in diameter (2 cm in diameter when projected on the viewing screen owing to the magnification), was also recorded as 'normal'.

Statistical analysis

The data were analysed using the SPSS 11.5 for Windows (SPSS Inc., Chicago, IL, USA). The validity of photographic examinations was assessed by measuring the levels of agreement between photographic and clinical diagnoses (gold standard). The levels of agreement for the diagnoses of the principle categories of DDE and the highest extent of DDE at the subject level, and for the diagnoses of the various subtypes and extent of DDE at the tooth level, were assessed using the kappa statistics (21), as a proportion of the possible scope for doing better than chance. The kappa coefficients were divided into ranges of values in the manner described by Landis and Koch (22). The levels of agreement in the diagnoses of the mean number of teeth affected by DDE were measured by assessing standardized differences. Standardized differences were obtained from mean directional differences divided by standard deviations of directional differences. A standardized difference value of 0.2 was taken to be small, 0.5 to be moderate, and 0.8 to be large (23). Significant differences overall in the diagnoses of prevalence and extent of DDE between the clinic and photographic assessments were analysed by McNemar test; while the paired *t*-test was used to detect significant differences overall in diagnoses of the mean number of teeth affected by DDE. The level of statistical significance was set at 0.05.

Results

A total of 257 children aged from 10 to 12 years old were clinically examined in this study [133 (51.8%) boys and 124 (48.2%) girls]. Since five intra-oral photographs were taken of the anterior teeth of each child, 257 'five-view', 'three-view', and 'one-view' slide sets were subsequently available for photographic examinations. Uneruption of a canine ($n = 93$) was the main reason for excluding a tooth in the clinical examination. Other reasons for exclusion of teeth included plaque/stain ($n = 9$), missing or uneruption ($n = 6$), fractures ($n = 3$) and restorations ($n = 3$); this led to the exclusion of 21 incisors. Therefore, 2970 teeth were included in the analysis of the clinical results, and theoretically the same number of buccal surfaces was available for analysis in the photographic phase. However, only 2967 tooth surfaces were examined for DDE in the 'five-view' and the 'three-view' slide sets, and only 2715 tooth surfaces could be examined in the 'one-view' slide set. This represented a further loss of 0.1% (three of 3084) in the 'five-view' and 'three-view' slide sets and, 8.3% (255 of 3084) in the 'one-view' slide set of the original data. The reasons for excluding the extra data in the 'five-view' and 'three-view' slide set were overlapping ($n = 2$) and rotation ($n = 1$) of the maxillary lateral incisors. The main reasons for excluding data in the 'one-view' slide set were

Table 1. The percentage of the 257 Chinese children in Conghua with at least one anterior tooth affected by the various types of DDE in the clinical and photographic phase of the study

		Photographic examination		
Type of DDE	Clinical examination	'Five-view' slide set	'Three-view' slide set	'One-view' slide set
Any defect	33.9	34.6	34.6	36.6
Principal category of DDE				
1. Demarcated opacities	14.0	15.2	14.0	14.0
2. Diffuse opacities	23.3	23.7	24.1	26.5
3. Hypoplasia	2.3	2.7	2.7	1.6
4. Combination of three main types	3.9	3.1	2.7	2.7
Subtype of DDE				
1.1 Demarcated opacities (white/cream)	12.8	13.2	12.5	12.0
1.2 Demarcated opacities (yellow/brown)	1.2	2.0	1.5	2.0
2.1 Diffuse opacities – lines/patchy	23.3	23.7	24.1	26.5
2.2 Diffuse opacities – confluent	0	0	0	0
2.3 Confluent/patchy + staining + loss of enamel	0	0	0	0
3.1 Hypoplasia – pits	0.4	0.8	0.8	0.4
3.2 Hypoplasia – missing enamel	1.9	1.9	1.9	1.2
4.1 Demarcated opacities + diffuse opacities	3.5	3.1	2.7	2.7
4.2 Demarcated opacities + hypoplasia	0	0	0	0
4.3 Diffuse opacities + hypoplasia	0.4	0	0	0
4.4 All three main types	0.4	0	0	0

rotation of the canines ($n = 141$), overlapping ($n = 39$) and rotation ($n = 31$) of the lateral incisors, and photographic burn-out of the central incisors ($n = 44$).

The prevalence of the various types of DDE in the 257 children, at the subject level, in the clinical phase of the study, is given in Table 1. The distribution of the highest extent of DDE at the subject level were 66.1% ($n = 170$) for the category of normal, 23.3% ($n = 60$) for extent less than one-third of the tooth surface, 4.7% ($n = 12$) for at least one-third to two-third, and 5.8% ($n = 15$) for at least two-third. The mean number of teeth affected by DDE per person was 1.2 (SD = 2.28).

Validity of photographic method

The levels of agreement between the clinical and photographic recording methods for the diagnoses of 'any defect' and the principle categories of enamel defects at the subject level using the modified FDI (DDE) Index are displayed in Table 2. The levels of agreement between the diagnoses of the highest extent of DDE at the subject level made from the clinical and the photographic examinations were k = 0.86 for both the 'five-view' and 'three-view' slide sets, and k = 0.82 for the 'one-view' slide set. The standardized differences for assessments of the mean number of teeth affected by DDE between the clinical and photographic examinations were in the range of 0.11–0.13. At the tooth level, the levels of agreement between the clinical and the photographic examinations for the diagnoses of the various subtypes and extent of DDE in each anterior tooth are presented in Table 3. Agreement ranged from 0.61 (for left maxillary canine 'one-view') to 0.91 (right maxillary central incisor 'five-view') with respect to diagnoses of the various subtypes of DDE, and from 0.65 (left mandibular canine 'one-view') to 0.91 (right maxillary central incisor 'five-view') with respect to extent of DDE.

There were no significant differences, at the subject (the prevalence and highest extent of DDE, and the mean number of teeth affected by DDE) and tooth level (the prevalence and extent of DDE), between the clinical assessments and the photographic examinations of the multiple views (the 'five-view' and the 'three-view' slide sets). However, it was found that there were significant differences in the 'one-view' slide set at the tooth level, including the assessments for the various subtypes of DDE in the maxillary right canines ($P = 0.018$), maxillary left canines ($P = 0.009$), and mandibular left canines ($P = 0.024$), and the assessment for the extent of DDE in mandibular left canines ($P = 0.044$).

Reliability of photographic method

Approximately 12% of the children ($n = 31$) and the slide sets (31 × 3 sets) were re-examined in this study. Using the data for intra-examiner comparisons, the kappa coefficients were 0.88 for the diagnoses of 'any defect' of DDE in both the 'three-view' and 'one-view' slide sets (Table 4). The intra-examiner agreement for determine the highest extent of DDE at the subject level was k = 0.85, k = 0.90, and k = 90 for the 'five-view,' 'three-view', and 'one-view' slide sets, respectively, whilst the kappa value was 0.81 for the clinical examination. The standardized differences for assessments of the mean number of teeth affected by DDE were in the range of 0.23–0.29 for the clinical and photographic examinations. At the tooth level, the intra-examiner reproducibility in the clinical and the photographic examinations for the diagnoses of the various subtypes and extent of DDE in each anterior tooth are presented in Table 5.

Table 2. The levels of agreement between the clinical and photographic examinations of the study for the diagnoses of 'any defect' and the principle categories of enamel defects at the subject level using the modified FDI (DDE) Index

	'Five-view' slide set versus clinical examination		'Three-view' slide set versus clinical examination		'One-view' slide set versus clinical examination	
Type of DDE	Kappa value	Level of agreement	Kappa value	Level of agreement	Kappa value	Level of agreement
Any defect	0.85	Almost perfect	0.85	Almost perfect	0.79	Substantial
Principle category of DDE						
1. Demarcated opacities	0.86	Almost perfect	0.84	Almost perfect	0.81	Almost perfect
2. Diffuse opacities	0.86	Almost perfect	0.83	Almost perfect	0.77	Substantial
3. Hypoplasia	0.83	Almost perfect	0.83	Almost perfect	0.76	Substantial
4. Combination of three main types	0.77	Substantial	0.73	Substantial	0.73	Substantial

Table 3. Kappa agreement between the clinical and the photographic examinations of the study for the diagnoses of the various DDE subtypes and DDE extent in each anterior tooth using the modified FDI (DDE) Index

	'Five-view' slide set versus clinical examination		'Three-view' slide set versus clinical examination		'One-view' slide set versus clinical examination	
Tooth type	DDE subtype	DDE extent	DDE subtype	DDE extent	DDE subtype	DDE extent
Maxillary						
13	0.89	0.88	0.90	0.86	0.63	0.73
12	0.86	0.84	0.85	0.83	0.82	0.81
11	0.91	0.91	0.90	0.90	0.89	0.89
21	0.89	0.89	0.90	0.89	0.87	0.88
22	0.85	0.87	0.83	0.84	0.81	0.82
23	0.90	0.89	0.89	0.90	0.61	0.71
Mandibular						
43	0.81	0.85	0.81	0.81	0.69	0.67
42	0.82	0.85	0.81	0.88	0.73	0.76
41	0.78	0.81	0.76	0.83	0.74	0.78
31	0.76	0.82	0.73	0.82	0.71	0.77
32	0.81	0.83	0.79	0.86	0.77	0.83
33	0.82	0.89	0.81	0.85	0.67	0.65

Discussion

When comparing clinical and photographic assessment there is a possibility of bias because of 'foreknowledge' of the clinical situation. To limit any potential bias the photographic assessments were conducted 3 months after the clinical assessments. Furthermore, transparencies were randomly selected for viewing such that the potential bias effect of recalling any situation was minimized. In addition, agreement between clinical and photograph assessment was assessed not only at the subject level but also at the tooth level which would be highly improbable to recall.

With both clinical and photographic assessments of DDE it is inevitable that some teeth will be excluded from the analysis because of restorations, fractures, etc. Although, as in this study the number was small. The most common reason for differences in the number of teeth assessed clinically compared with photographic assessment of DDE was because of the 'burn-out' effect, rotations and overlapping of teeth, notably when using only a frontal 'one-view'. With multiple views it was possible to minimize the number of teeth excluded (to a mere 0.1%); however, there was no advantage over using the 'five-view' compared with 'three-view' slide sets in this respect.

At the subject level, there was good agreement between the clinical and photographic assessments in the diagnoses of the prevalence and extent of DDE. In addition, the standardized differences in the mean number of teeth affected by DDE when the clinical and photographic examinations were compared could be interpreted as 'small' (23). A frontal 'one-view' photograph appears adequate to assess the prevalence, extent and mean number of anterior teeth affected by DDE.

However, variations between clinical and photographic assessments of DDE were apparent at the tooth level in terms of agreement in the prevalence and extent of DDE. Notably, with a 'one-view' slide set the level of agreement about the prevalence and extent of DDE among canines was relatively low and there was a statistical difference. This suggests that a frontal 'one-view' photograph is only adequate to assess the prevalence and extent of DDE among incisor teeth. Thus, when conducting analyses at the tooth level multiple photographic views are more appropriate. However, there was minimal difference in the

Table 4. Intra-examiner reproducibility in the clinical and photographic examinations of the study for the diagnoses of 'any defect' and the principle categories of enamel defects using the modified FDI (DDE) Index

	Clinical examination		Photographic examination					
			'Five-view' slide set		'Three-view' slide set		'One-view' slide set	
Type of DDE	Kappa value	Level of agreement	Kappa value	Level of agreement	Kappa value	Level of agreement	Kappa value	Level of agreement
Any defect	0.82	Almost perfect	0.81	Almost perfect	0.88	Almost perfect	0.88	Almost perfect
Principle category of DDE								
1. Demarcated opacities	0.83	Almost perfect	0.79	Substantial	0.88	Almost perfect	0.91	Almost perfect
2. Diffuse opacities	0.72	Substantial	0.77	Substantial	0.87	Almost perfect	0.87	Almost perfect
3. Hypoplasia	0.84	Almost perfect	0.84	Almost perfect	0.78	Substantial	0.76	Substantial
4. Combination of three main types	0.76	Substantial	0.78	Substantial	0.87	Almost perfect	0.89	Almost perfect

Table 5. Intra-examiner reproducibility in the clinical and the photographic examinations of the study for the diagnoses of the various DDE subtypes and DDE extent for each anterior tooth using the modified FDI (DDE) Index

	Clinical examination		Photographic examination					
			'Five-view' slide set		'Three-view' slide set		'One-view' slide set	
Tooth type	DDE subtype	DDE extent	DDE subtype	DDE extent	DDE subtype	DDE extent	DDE subtype	DDE extent
Maxillary								
13	0.81	0.83	0.79	0.81	0.82	0.83	0.71	0.73
12	0.81	0.82	0.84	0.85	0.85	0.87	0.85	0.92
11	0.84	0.88	0.85	0.89	0.86	0.92	0.91	0.95
21	0.89	0.88	0.84	0.87	0.84	0.93	0.88	0.94
22	0.82	0.81	0.84	0.84	0.84	0.84	0.83	0.82
23	0.81	0.85	0.78	0.79	0.83	0.83	0.73	0.74
Mandibular								
43	0.81	0.84	0.87	0.85	0.87	0.88	0.82	0.81
42	0.78	0.79	0.81	0.82	0.84	0.84	0.84	0.84
41	0.78	0.78	0.73	0.75	0.78	0.84	0.81	0.84
31	0.73	0.76	0.76	0.78	0.84	0.84	0.84	0.85
32	0.77	0.77	0.75	0.75	0.81	0.84	0.84	0.83
33	0.79	0.81	0.87	0.84	0.87	0.87	0.83	0.81

level of agreement between the 'three-view' and 'five-view' slide sets compared to clinical assessments of DDE. In terms of reliability, photographic assessments were as reliable as clinical examinations for assessing DDE at both the subject and tooth level. Moreover, a frontal 'one-view' photograph was as reliable as the 'three-view' or 'five-view'.

Some authors found that the prevalence of DDE recorded by photographic methods was higher than that recorded by clinical examinations, and the authors attributed the difference to the magnification of the photographic images on the screen (4, 9, 11, 15). Unfortunately, it is difficult to compare the data from the present study with that of the various published studies because of the differences in the clinical and photographic methods, examination criteria, and data analyses. For example, there were no reported data on the standardized differences for the diagnoses of the mean number of teeth affected by DDE between the clinical and photographic method in any of the other studies. More importantly, the variation of type, prevalence and severity of enamel defects recorded in each study would affect the agreement. It is obvious that the agreement levels will be higher if more of the examined people are free of DDE (24). The prevalence of DDE for the chosen sample of this study was similar to that reported by other researchers from fluoridated areas (12, 25). The wide range of enamel defects which was detected in this group of children enabled this study to evaluate the validity and reliability of photographic recording methods in relation to the subtypes of DDE.

The high levels of agreement between the clinical and photographic examinations obtained for the multiple-view sets of slides in this study can be attributed to the standardized technique employed. The use of good quality lighting, e.g. the fibre-optic light in the clinical examination and a ring flash to minimize shadows in the photograph, made the lightning conditions similar to that of the operating light used in the dental clinic. When natural light has been used in the clinical examination, lower prevalence figures have been reported than when using the photographic method (11, 15). Moreover, the magnification effect was minimized as much as possible in the photographic assessments. The transparencies were viewed on a screen at a set magnification with the examiner at a set distance from the screen, and only defects >2 cm in diameter on the screen were recorded. Clinically, these enamel defects would escaped casual observation (they would be <1 mm on the children's teeth) and so could not be considered to cause a cosmetic problem (26). In addition, the teeth were examined wet in the clinical phase as well as the photographic phase because the children could close their mouths before the photographic retractors were placed in the mouth. If the children were to have retractors in the mouth through out the clinical examination, the surface of the teeth would become more dehydrated and some enamel defects would be more apparent when taking the photographs subsequently (27). Surprisingly, most authors have

neglected to mention whether or not the teeth were wet or dry when taking the photographs. While the above mentioned factors are important, clearly defined diagnostic criteria, the careful calibration and training of examiners, and the cleaning of the surfaces of the teeth all contributed to the high levels of agreement.

In conclusion, this study demonstrated that standardized photographic slides are a valid and reliable method to diagnose DDE. When assessing DDE at the subject level, a single frontal-view photograph was adequate. However, as it is hard to predict the problem of photographic burn-out, and because of rotations and overlapping of teeth, multiple views maybe required. Photographs of multiple views are more appropriate to use when assessing DDE at the tooth level, since the level of agreement between photographic and clinical assessment among canines was relatively weak for the single frontal view. There was no apparent advantage of using the 'five-view' over the 'three-view' slide sets suggesting that a frontal and right and left lateral views are adequate to assess DDE among the 12 anterior teeth.

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