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Dental practitioners' views on the need to treat developmental defects of enamel

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Abstract – *Objectives:* To assess dental practitioners' views on the need to treat developmental defects of enamel (DDE). In addition, to identify factors associated with practitioners' treatment decision (tooth factors and dentist-related). *Methods:* A random sample of 300 Hong Kong dentists were sent a booklet containing computer-generated images of various forms of DDE and asked to rate the treatment need. In addition, some dentist-related information was collected. *Results:* The response rate was 79% (237/300). The majority of the dental practitioners considered that aesthetic treatment was indicated for people with DDE subtypes of brown demarcated opacities (51.0%), confluent/patchy plus staining and/or loss of enamel (80.2%), missing enamel (67.1%) and the combination of discolouration and diffuse opacities (83.1%); their decisions were in relation to the type ($P < 0.001$), size ($P = 0.001$) and colour ($P < 0.001$) of the enamel defects. Dental professionals who were older, self-employed, graduated from institutions overseas, or had postgraduate qualifications, tended to consider aesthetic treatment for the teeth that exhibited the milder forms of enamel defects ($P < 0.05$). *Conclusions:* Dentists frequently perceive that DDE constitutes a 'great need' for dental treatment. Dentists' perceptions of the need to treat DDE is influenced by type, size and colour of DDE and associated with dentist-related factors, principally the age of the dentist.

Key words: clinical decision making; developmental defects of enamel; treatment need

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Developmental defects of enamel (DDE), including fluorosis, is a popular area of dental research (1). Although they vary greatly in appearance, enamel defects can be divided into three basic types – demarcated opacities, diffuse opacities and hypoplasia (2, 3). Numerous studies have focused on establishing the risk factors and assessing the prevalence of DDE (4, 5). From the patients' perspective, the aesthetics of DDE are their prime concern and this concern is shared by dental professionals (6). That is, only the defects that are cosmetically unacceptable are of public health importance. Unfortunately, none of the indices, so far developed, measures these variables directly. Therefore, little attention has been given to determine either professionals or publics' opinions on the aesthetic problems caused by enamel defect or their need for treatment. The majority of the studies that have investigated the perceived treatment need for enamel defects have only considered those enamel defects thought to be due to fluorosis (7–9). Hence, the findings do not reflect on the full range of DDE that may affect the aesthetics of an individual.

The aesthetic acceptability and the public health significance of DDE have proved difficult to quantify (10). When objectivity is the prerequisite in a scientific study, any part of the face and teeth, other than the actual enamel defects, may introduce bias during clinical examinations by distracting or influencing the examiner (11). To date, there have been no reports of research that have solicited the perceptions of aesthetics and/or treatment needs from a representative sample of lay people or dental professionals.

The perceptions of dental aesthetics can vary from individual to individual depending on factors

such as gender and age (12). The question of whether a condition is acceptable or not may be difficult to justify when the condition, for example enamel defects in Hong Kong, is present in the majority of a population (13). Arguably, dental practitioners who by the nature of their dental training may have a professional and constant opinion about the treatment needs for DDE (14). Thus, the aim of this study was to assess Hong Kong dental practitioners' views of the aesthetics and the treatment needs due to DDE, by using a set of standardised, computer-generated photographic images showing teeth with the different types of DDE.

Materials and methods

Sampling method

The participants in this target population of this survey were all registered and active dental practitioners in Hong Kong. The sampling frame was based on the list of registered dentists as of the beginning of the year 2003. The list was provided by the Hong Kong Dental Council and therefore provided the most complete sampling frame available. The list of registered dentists consisted of 1912 names. Dentists who were not practicing in Hong Kong were excluded. The revised list of 1709 names was arranged in alphabetical order. From this list, a random sample of 300 was drawn for inclusion in this survey.

Development of data collection material

A booklet which contained photographic images in conjunction with the questionnaire soliciting dental practitioners' aesthetic perceptions and treatment needs in relation to DDE was developed for use in this survey. A set of clinical photographs with or without DDE was taken using a Fujifilm FinePix S1 Pro digital camera fitted with a Medical-NIKKOR 120-mm lens. These digital photographs were subsequently downloaded onto a DELL PIII-866-MHz computer and then altered using the ADOBE PHOTOSHOP computer program, Version 6.0. A life-size digital image of the anterior teeth with the lips cropped off was used as a template. This image showed well-aligned teeth of normal size, shape, colour and with healthy gingivae. Using the photo-editing functions of the ADOBE PHOTOSHOP computer program, different types of enamel defects on the digital photographs, according to the modified version of the FDI (DDE) Index (2), were added onto the template. These images were reviewed by a panel of 10 dentists at the Faculty of Dentistry, the University of Hong Kong, and subsequently modified to ensure the realism of the computer-generated images.

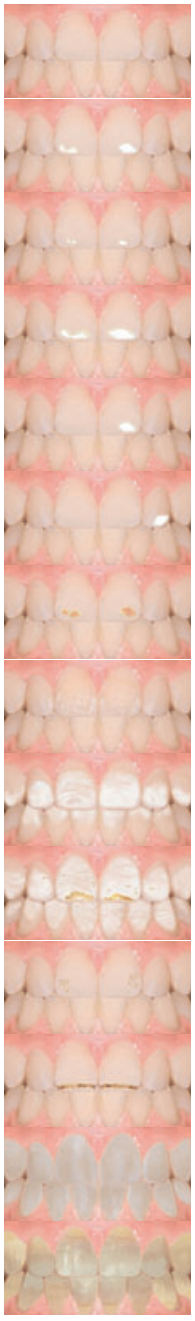
These computer-generated images were printed onto Fujicolor Crystal Archive photographic paper by a commercial photographic laboratory and bound, using comb rings into booklets. Part A of the booklet included 14 photographic images of different types of DDE and two repeated images. All of these images were placed in a random sequence in the master copy of the booklet. Part B of the booklet included the same set of 14 images as in Part A but in a different sequence and again two of the images were repeated. All duplicate copies of the booklets contained these images in the same sequence in Part A and B. The participants were given no specific information about the defects that they were expected to evaluate. There was one image printed on each page so that the participants could only view one image at a time and so they were unable to make direct comparisons. Table 1 summarises the characteristics of the 14 photographic images used in this survey.

A questionnaire, intended for use with the photographic booklet, and for independent completion, was designed with two parts. In Part A of the questionnaire, the dental practitioners were requested to look at Part A of the photographic booklet and to rate, on an ordinal scale of 1–7, the appearance of the teeth on each photograph displayed, with 1 indicating that they considered the appearance of the teeth to be very pleasing and 7 being very unacceptable. In Part B of the questionnaire, the dental practitioners were asked to look at Part B of the photographic booklet and to rate the extent of their agreement with the statement that, 'these teeth need treatment to improve their appearance'. The possible answers were based on a scale from 1 to 7, with 1 being disagree strongly with the statement, meaning that there was no need for treatment, and 7 being agree strongly, meaning that there was a great need for treatment. The appropriate rating was recorded by ticking the appropriate box by the side of the code number of the photograph on a specially prepared data recording sheet.

Data collection

Approval to conduct this study was received from the Ethics Committee, Faculty of Dentistry, the University of Hong Kong. The questionnaire,

Table 1. The type, extent and presentation of developmental defects of enamel (DDE) of 14 computer-generated photographic images displayed in the photographic booklets in the survey of dental practitioners in Hong Kong

Photographic image	Type	Extent	Presentation
	Normal	-	(template)
	White demarcated opacities	<1/3	2 medium sized defects (4mm in width) on tooth 11 and 21
	White demarcated opacities	<1/3	2 small sized defects (2mm in width) on tooth 11 and 21
	White demarcated opacities	<1/3	2 large sized defects (6mm in width) on tooth 11 and 21
	White demarcated opacities	<1/3	Single medium sized defect (4mm in width) on tooth 21
	White demarcated opacities	<1/3	Single medium sized defect (4mm in width) on tooth 22
	Brown demarcated opacities	<1/3	2 medium sized defects (4mm in width) on tooth 11 and 21
	Diffuse lines/patchy	1/3 - 2/3	Defects on maxillary incisors
	Diffuse confluent	>2/3	Defects on all anterior teeth
	Confluent/patchy + staining + loss of enamel	>2/3	Defects on all anterior teeth
	Pits	<1/3	Defects on tooth 11 and 21
	Missing enamel	<1/3	Defects on tooth 11 and 21
	Discolouration	>2/3	Defects on all anterior teeth
	Discolouration + diffuse opacities	>2/3	Defects on all anterior teeth

marked with a unique reference number for each participant, the photographic booklet, a stamped return addressed envelope and an accompany explanatory letter were all sent to each selected dentist by mail. In the letter, the purpose of the survey was explained and the instructions for completion of the questionnaire were provided. The dentists were requested to complete the questionnaire and return it by mail using the enclosed stamped envelope. If they wished, the dentists were allowed to keep the photographic booklet for use in their dental practice.

One day before, the questionnaires were dispatched, contact was made, by telephone, with each potential participant to confirm their address. One week after the mailing of the questionnaires,

two rounds of follow-up telephone calls were made to the nonrespondents. New questionnaires were sent to those dentists who had not received, or who had lost their questionnaires. The collection of the completed questionnaires was limited to a period of 1 month. The information regarding the dentists' background (age, gender, place of graduation and level of education in dentistry) and practice characteristics (specialty and employment) was obtained from the list of registered dentists provided by the Hong Kong Dental Council.

Statistical analysis

The questionnaire data and the information regarding the dentists' background and practice characteristics were reviewed, matched, and then entered into a DELL PIII-866-MHz computer. The software program SPSS 11.5 for Windows (15) was used to analyse the data. To measure the reliability of the dental practitioners involved in this survey for the ratings of the displayed photographs of the various types of DDE, the Kappa statistic (16) was calculated and grouped according to the recommendation of Landis and Koch (17) utilising the four repeated photographs. The correlation between the dental practitioners' ratings of how they considered the appearance of the teeth and their perceived treatment need for the teeth displayed in the photographic booklet were measured using the Spearman's ρ test.

In Part A of the questionnaire, the frequencies of the responses were aggregated into two groups, namely acceptable (scale points 1–5), and unacceptable (scale points 6–7). In Part B of the questionnaire, the frequencies of the responses were dichotomised into 'no treatment need' (scale points 1–5) and 'great treatment need' (scale points 6–7). Using the dichotomised data, the ratings of treatment need among the different types and presentations of DDE were tested employing the Cochran Q test. The ratings of treatment needs for the various types of DDE in relation to some aspects of the background and practice characteristics of the respondents were detected using the Student's *t*-test (for age) and the chi-squared test (for the place of graduation, education, specialty and employment), respectively. Significance levels of $P < 0.05$ were regarded as statistically significant and only two-tailed tests were used.

On the basis of these assessments, backward stepwise logistic regression analyses were performed to determine the relative importance of the factors that affected the ratings of treatment need for the various types of DDE by the dental practitioners in Hong Kong. A set of independent variables including age, gender, the place of graduation, the education level, the specialty and the employment of the respondents were considered. The significance level chosen for retention of a variable in the model was 0.05, and 95% confidence intervals of the odds ratio were calculated for all variables that were retained in the final logistic model.

Results

Response rates

Out of the 1709 registered and active dental practitioners in Hong Kong, 300 were randomly selected and sent a questionnaire; and as 237 responded, the response rate was 79.0% (237/300). Some aspects of the background and practice characteristics of the respondents are shown in Table 2.

Respondent reliability

To measure the reliability of the dental practitioners for the ratings of the displayed photographs in relation to the various types of DDE, two of the 14 photographs in the photographic booklet for each question were repeated. Using the data for comparisons, the unweighted Kappa values were 0.68 and 0.79, respectively, for the rating of the appear-

Table 2. Background and practice characteristics of the 237 dental practitioners. Background and practice characteristics

	Number	Percentage
Age		
21–30 years old	51	21.5
31–40 years old	121	51.1
41–50 years old	49	20.7
>50 years old	16	6.8
Gender		
Male	189	79.7
Female	48	20.3
Place of graduation		
The University of Hong Kong	159	67.1
Overseas	78	32.9
Education		
BDS or DDS	178	75.1
Postgraduate degree	59	24.9
Specialty		
General dental practitioner	232	97.9
Specialist	5	2.1
Employment		
Self-employed	186	78.5
Salaried	51	21.5

ance of 'normal' teeth and diffuse lines/patchy. The Kappa statistics for rating the treatment need of the repeated photographs of 'normal' teeth and brown demarcated opacities were 0.63 and 0.81, respectively.

Correlation coefficients between perceptions of aesthetics and treatment needs

The Spearmen's ρ values for the ratings of the 237 dental practitioners indicating how they evaluated the appearance of the teeth and the treatment need for each of the photographs displayed in the photographic booklet were in the range of 0.40 (brown demarcated opacities) to 0.61 (discolouration) for the different subtypes of DDE. The correlations were considered to be statistically significant because they all reached the 0.01 level for the various subtypes of DDE.

Ratings of the various types of DDE

Table 3 shows the distribution of the responses for the perceptions of aesthetics and treatment need for the teeth displayed in the photographic booklet. The majority of the respondents in this survey had the perceptions that some subtypes of DDE are aesthetically unacceptable such as the diffuse confluent (59.6%), confluent/patchy plus staining and/or loss of enamel (83.5%), missing enamel (63.3%), discolouration (60.0%) and the combination of discolouration and diffuse opacities (94.1%). Most of the respondents considered that treatment was necessary for the following subtypes of DDE: brown demarcated opacities (51.0%), confluent/patchy plus staining and/or loss of enamel (80.2%), missing enamel (67.1%) and the combination of discolouration and diffuse opacities (83.1%).

Factors that affected the treatment need ratings – type and presentation of DDE

Statistical significance was found at the $P < 0.001$ level among the various subtypes of DDE for ratings of treatment need by the 237 dental practitioners. It was also found that there were statistically significant differences in the ratings for the different sizes of white demarcated opacities ($P = 0.001$) and in the ratings for the different colours of demarcated opacities ($P < 0.001$), see Table 4.

Factors that affected the treatment need ratings – background and practice characteristics of respondents

When the ratings of treatment need were analysed for the various subtypes of DDE, variations were apparent for confluent/patchy plus staining and/or loss of enamel ($P = 0.009$), with a tendency for the older respondents (mean age = 37.8, SD = 8.50) to consider some level of treatment for this type of DDE compared with the slightly younger respondents (mean age = 34.7, SD = 6.65). Similar patterns of ratings were found to be statistically significant for small-sized white demarcated opacities ($P = 0.048$), single white demarcated opacities on the central incisor ($P = 0.018$) and on the lateral incisor ($P = 0.013$), diffuse lines/patchy ($P = 0.010$), diffuse confluent ($P = 0.016$) and discolouration ($P = 0.044$). Variations were also apparent for some DDE subtypes, e.g. small-sized white demarcated opacities ($P = 0.003$), large-sized white demarcated opacities ($P = 0.027$), white demarcated opacities on the central incisor ($P = 0.041$) and diffuse lines/patchy ($P = 0.005$), with a tendency for the respondents, who had graduated from institutions overseas, to consider some treatment for teeth with these types of DDE, while respondents who had graduated from the University of Hong Kong disagreed. However, statistical significance was not found for the ratings of treatment need for the various types of DDE in relation to gender, level of education in dentistry (undergraduate or postgraduate), the specialty in dentistry (general dental practitioner or specialist) and the type of employment (self-employed or salaried) of the 237 dental practitioners.

Further analysis was conducted employing logistic regression analysis to determine the effect of the background and practice characteristics of the Hong Kong dental practitioners on their ratings of treatment need for teeth with the various types of DDE. The association between age of the respondents and their ratings of treatment need for single white demarcated opacities on the maxillary central incisor ($P = 0.007$), single white demarcated opacities on the maxillary lateral incisor ($P = 0.007$), diffuse lines/patchy ($P = 0.002$), diffuse confluent ($P = 0.015$) and confluent/patchy plus staining and/or loss of enamel ($P = 0.024$) was evident (see Table 5). In addition, the dental practitioners who graduated from overseas universities ($P = 0.028$) and those who were employed by the government or other organisations ($P = 0.012$) more frequently considered that there was some degree of treatment need for the small-sized white demarcated opacities. The effect of the place of graduation was also apparent on the practitioners' ratings of treatment need for the

Table 3. Frequency of the responses of 237 dental practitioners to the Part A Question I: please rate the appearance of the teeth on a scale of 1–7, with 1 being very pleasing and 7 being very unacceptable; and the Part B Question I: 'these teeth need treatment to improve their appearance'. To what extent do you agree with this statement? Please rate on a scale of 1–7, with 1 being disagree strongly meaning that there is no need for treatment and 7 being agree strongly meaning that there is a great need for treatment

	Rating of aesthetics (Part A Question I)		Rating of treatment need (Part B Question I)	
Type of DDE (total responses = 237)	Acceptable (scale points 1–5) *n* (%)	Unacceptable (scale points 6–7) *n* (%)	No treatment need (scale points 1–5) *n* (%)	Great treatment need (scale points 6–7) *n* (%)
Normal	237 (100.0)	0 (0)	237 (100.0)	0 (0)
1.1 White demarcated opacities				
t11, t21 (medium)	206 (86.9)	31 (13.1)	190 (80.1)	47 (19.9)
t11, t21 (small)	232 (97.9)	5 (2.1)	207 (87.4)	30 (12.6)
t11, t21 (large)	184 (77.6)	53 (22.3)	187 (78.9)	50 (21.1)
t21 (medium)	217 (91.5)	20 (8.5)	191 (80.5)	46 (19.5)
t22 (medium)	216 (91.1)	21 (8.9)	182 (76.8)	55 (23.2)
1.2 Brown demarcated opacities	143 (60.3)	94 (39.7)	116 (49.0)	121 (51.0)
Diffuse opacities				
2.1 Diffuse opacities – lines/patchy	236 (99.6)	1 (0.4)	206 (87.0)	31 (13.0)
2.2 Diffuse opacities – confluent	96 (40.4)	141 (59.6)	141 (59.5)	96 (40.5)
2.3 Confluent/patchy + staining + loss of enamel	39 (16.5)	198 (83.5)	47 (19.8)	190 (80.2)
Hypoplasia				
3.1 Hypoplasia – pits	199 (84.0)	38 (16.0)	181 (76.4)	56 (23.6)
3.2 Hypoplasia – missing enamel	87 (36.7)	150 (63.3)	78 (32.9)	159 (67.1)
Other defects				
4.1 Discolouration	95 (40.0)	142 (60.0)	145 (61.1)	92 (38.9)
4.3 Discolouration + diffuse opacities	14 (5.9)	223 (94.1)	40 (16.9)	197 (83.1)

Table 4. The ratings of treatment need by the 237 dental practitioners for the teeth displayed in the photographs in relation to the various presentations of demarcated opacities

Presentation of demarcated opacities	No treatment need (%)	Great treatment need (%)	Cochran's Q	*P*-value
Size				
Medium-sized white defects (4-mm width)	80.1	19.9	13.170	0.001**
Small-sized white defects (2-mm width)	87.4	12.6		
Large-sized white defects (6-mm width)	78.9	21.1		
Number				
Two medium-sized white defects	80.1	19.9	0.027	0.869
Single medium-sized white defect	80.5	19.5		
Location				
Single medium-sized white defect on tooth 21	80.5	19.5	2.793	0.095
Single medium-sized white defect on tooth 22	76.8	23.2		
Colour				
Medium-sized white defects	80.1	19.9	60.844	<0.001***
Medium-sized brown defects	49.0	51.0		

Cochran Q test; $\alpha = 0.05$.
**$P < 0.01$; ***$P < 0.001$.

large-sized white demarcated opacities ($P = 0.028$). The respondents who had higher qualifications in dentistry scored 'great treatment need' more frequently ($P = 0.030$) for discolouration than those who only had a BDS or DDS degree (Table 5).

Discussion

The response rate of the random sample of 300 subjects, which was drawn from the 1709 registered dentists, was 79.0% (237/300), which is believed to be the highest for all of the studies,

Table 5. Summary of logistic regression analysis: ratings of treatment need by the 237 dental practitioners in Hong Kong (no treatment need versus great treatment need) for the various types of DDE (only statistical significant findings are displayed)

Dependent variables	Significant independent variables	Regression coefficient	SE	Odds ratio	95% CI	*P*-value
1.1 White demarcated opacities						
t11, t21 (small)	Place of graduation (0 = overseas, 1 = HKU)	−0.72	0.33	0.49	0.26, 0.93	0.028*
	Employment (0 = salaried, 1 = self-employed)	−1.19	0.48	0.30	0.12, 0.77	0.012*
t11, t21 (large)	Place of graduation (0 = overseas, 1 = HKU)	−0.72	0.33	0.49	0.26, 0.93	0.028*
t21 (medium)	Age	0.05	0.02	1.05	1.01, 1.10	0.007**
t22 (medium)	Age	0.05	0.02	1.05	1.01, 1.09	0.007**
2.1 Diffuse opacities – lines/patchy	Age	0.07	0.02	1.07	1.03, 1.12	0.002**
2.2 Diffuse opacities – confluent	Age	0.04	0.02	1.04	1.01, 1.08	0.015*
2.3 Confluent/patchy + staining + loss of enamel	Age	0.05	0.02	1.05	1.01, 1.10	0.024*
4.1 Discolouration	Education (0 = postgraduate, 1 = undergraduate)	0.66	0.30	1.94	1.07, 3.51	0.030*

HKU, the University of Hong Kong.
*$P < 0.05$; **$P < 0.01$.

which have targeted dental practitioners in Hong Kong (18–20). The final sample which consisted of 237 was comparable with those used in other studies of perceived treatment need of dentists (21, 22). Therefore, the 237 respondents in this survey can be considered to be representative and sufficient to provide valid data for registered actively practising dental practitioners in Hong Kong on their perceptions of aesthetics and treatment need for teeth affected by DDE.

A good correlation between assessments of dental and facial attractiveness has been made on live subjects and from photographic records (23). Therefore, it is legitimated to extrapolate the findings of the present study to live subjects. Because of the possibility of responses being affected by the heterogeneity of the teeth, gingivae and other tissues displayed in the photographs, a standard 'template' of anterior teeth was used and modifications were made to the various types and forms of DDE. By providing a set of homogenous teeth, the 'background noise' from individual variations could be expected to be minimised so that the respondents could focus on only the enamel defects. The images of the defects were deliberately modified so that the teeth would exhibit defects that had somewhat equal 'levels of severity' to allow meaningful comparisons. Therefore, most of the enamel defects were located in the incisal third of the maxillary incisors. However, some enamel defects, such as diffuse confluent and discolouration, were more extensive and had a distribution similar to the nature of these defects. Unlike the fluorosis indices, the classification of the modified version of the FDI (DDE) Index (2) is not designed to provide a grading of the severity; hence, this was another reason to make these minor modifications.

The reliability of the dental practitioners for the ratings of the photographs of the various types of DDE was in the 'substantial' to 'almost perfect' levels. The correlations were moderate to strong positive (ρ>0.40) for the ratings between the perceptions of aesthetics and treatment needs by the dental practitioners. The results of this study were generally consistent with those of other studies on fluorosis (24–26); the more severe types of DDE, e.g. confluent/patchy plus staining and/or loss of enamel, were considered to be more aesthetically unacceptable and had greater need for treatment than the milder forms of DDE such as diffuse lines/patchy (Table 3). These findings from the present study show that the standardised set of computer-generated photographic images with a simple questionnaire of the 'seven-point floating scale' is a reliable and valid means to determine dental practitioners' perceptions of the aesthetics and the treatment needs due to the various types of DDE.

Based on the dental practitioners' ratings in this survey, it would appear that some subtypes of DDE, such as the confluent/patchy plus staining and/or loss of enamel, missing enamel and the combination of discolouration and diffuse

opacities, are aesthetically unacceptable and some treatment is necessary for these defects (Table 3). In 1983, more than 20% of the 12 years old children in Hong Kong were found to be affected by these enamel defects (27). However, more information in relation to public perceptions is required before any definite conclusions, about the clinical implications, can be reached. With respect to aesthetic concerns, some enamel defects, such as diffuse confluent and discolouration, were aesthetically unacceptable but the dental practitioners were conservative about their treatment, while the dental practitioners held the opposite opinion about brown demarcated opacities (Table 3). It has been said that dentists would be unlikely to endorse unnecessary treatment or to provide treatment that entails risk for the tooth or gingivae because they have knowledge about the adverse effects of bleaching, etching and the provision of veneers or crowns (28, 29). In addition, it can be assumed that the respondents would be knowledgeable about treatment factors such as expense, duration, discomfort and inconvenience. Therefore, discrepancy between perceptions of aesthetics and treatment need may have occurred because of different levels of training and knowledge in that some dentists may have considered that although treatment could be provided it was not recommendable. This problem may or may not have occurred with lay people as they would be expected to have less knowledge of treatment options. However, no studies have reported on this issue.

The results from this survey suggested that the dental practitioners' ratings of treatment need were in relation to the type, size and colour of DDE (Table 4). Ellwood and O'Mullane (14) also found that the size of demarcated opacities and the degree of enamel hypomineralisation were related to children's satisfaction with the appearance of their affected teeth. However, there are no other published studies available with which to directly compare. Interestingly, there was much discrepancy with respect to practitioners' ratings of treatment need for DDE (depending on the type, size and colour of defects), which suggest that depending on practitioner consulted patients might receive different recommendations for treatment. This highlights the needs for guidelines with respect to treatment of enamel defects. However, it is appreciated that the implementations of clinical guidelines in dental practice is fraught with difficulties and there is little evidence that it can actually influence variations in prescription of treatment (30, 31). It is important that any guidelines on the treatment of DDE should be evaluated.

Previous investigations have found that females tend to express greater concern about facial appearances than males (32, 33). Data in relation to the background and practice characteristics of the respondents were also analysed in this study. Whilst the current sample included less female dental professionals than males, the chi-squared test failed to detect any gender influence on the threshold chosen for the aesthetic treatment. It was found that, using the Student's *t*-test and chi-squared test, dentists in order age and those that graduated from institutions overseas were more inclined to rate 'great treatment need' for some milder types of DDE. The first Bachelor Degree in Dental Surgery was awarded by the University of Hong Kong in 1985; therefore, all of the 'older' respondents involved in this survey would have graduated from institutions overseas. It was difficult to tell whether the age or the place of graduation was actually the factor that affected the respondents' ratings by using the Student's *t*-test and chi-squared test. Therefore, further analysis was conducted employing logistic regression analysis. Results from Table 5 show that age was the more significant independent variable and the effect of the place of graduation was only apparent on one subtype of DDE. Clark and Berkowitz (34), using logistic regression analysis, also found that a child's aesthetic perception of dental fluorosis changed with age. Except for the change that could be expected simply because a dentist is older, the more experienced dental practitioners might be more familiar with the demands and requirements of patients, or they might be more business orientated.

The findings ascertained in this study relate to dental practitioners' ratings of treatment need of developmental enamel defects using a standardised set of computer-generated images where the size, shape, shade and alignment of teeth were controlled for, as these anomalies can introduce an element of bias by distracting or influencing the rater's decisions (35). In reality, practitioners' perceptions and ultimately their decision to treat such cases are likely to be influenced by a host of factors including patient characteristics and other oral health features as with all treatment decisions. Moreover, as enamel defects are ultimately cosmetic factor, patients' own perceptions are likely to be of paramount importance in determining whether treatment is carried out or not.

In conclusion, the findings of this study suggested that enamel defects such as confluent/patchy plus staining and/or loss of enamel, missing enamel and the combination of discolouration and diffuse opacities were aesthetically unacceptable to dental professionals, and were perceived to have a 'great treatment need' by most of the practitioners. Their perceptions of treatment need were related to the different type, size and colour of the enamel defects. Although dentists might be expected to consistently recognise dental treatment because of their similar training, this study demonstrated that factors such as their age, place of graduation, level of education and type of employment can influence their perceptions of treatment need for DDE.

References

1. Whelton HP, Ketley CE, McSweeney F, O'Mullane DM. A review of fluorosis in the European Union: prevalence, risk factors and aesthetic issues. Commun Dent Oral Epidemiol 2004;32(Suppl. 1):9–18.
2. FDI Commission on Oral Health, Research and Epidemiology. A review of the developmental defects of enamel index (DDE Index). Int Dent J 1992;42:411–26.
3. Clarkson J. Review of terminology, classifications, and indices of developmental defects of enamel. Adv Dent Res 1989;3:104–9.
4. Pindborg JJ. Aetiology of developmental enamel defects not related to fluorosis. Int Dent J 1982;32:123–34.
5. King NM, Wei SHY. A review of the prevalence of developmental enamel defects in permanent teeth. J Paleopathol 1992;2:342–57.
6. Suzuki M, Jordan RE, Skinner DH, Boksman L. Clinical management of non-carious enamel defects. Int Dent J 1982;32:148–58.
7. Clark DC. Evaluation of aesthetics for the different classifications of the tooth surface index of fluorosis. Commun Dent Oral Epidemiol 1995;23:80–3.
8. Woodward GL, Main PA, Leake JL. Clinical determinants of a parent's satisfaction with the appearance of a child's teeth. Commun Dent Oral Epidemiol 1996;24:416–8.
9. Sigurjóns H, Cochran JA, Ketley CE, Holbrook WP, Lennon MA, O'Mullane DM. Parental perception of fluorosis among 8-year-old children living in three communities in Iceland, Ireland and England. Commun Dent Oral Epidemiol 2004;32(Suppl. 1):34–8.
10. McKnight CB, Levy SM, Cooper SE, Jakobsen JR. A pilot study of esthetic perceptions of dental fluorosis versus selected other dental conditions. J Dent Child 1998;65:233–8.
11. McKnight CB, Levy SM, Cooper SE, Jakobsen JR, Warren JJ. A pilot study of dental students' esthetic perceptions of computer-generated mild dental fluorosis compared to other conditions. J Public Health Dent 1999;59:18–23.
12. Cochrane SM, Cunningham SJ, Hunt NP. A comparison of the perception of facial profile by the general public and 3 groups of clinicians. Int J Adult Orthodon Orthognath Surg 1999;14:291–5.
13. King NM, Wei SHY. Developmental defects of enamel: a study of 12-year-olds in Hong Kong. J Am Dent Assoc 1986;112:835–9.
14. Ellwood RP, O'Mullane DM. Enamel opacities and dental esthetics. J Public Health Dent 1995;55: 171–6.
15. SPSS Inc. SPSS 11.5 for windows. Chicago: SPSS Inc.; 2002.
16. Cohen J. A coefficient of agreement for nominal scales. Educ Psychol Meas 1960;20:37–46.
17. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977;33:159–74.
18. Lo ECM, Yeung JCYY. The 2000 Hong Kong dental practice profile survey. Hong Kong Dent Assoc Millennium Rep 2001;2:38–42.
19. Newsome PR, Sun DY, Walter RP. A survey of Hong Kong dentists' attitudes towards advertising. Int Dent J 2001;51:428–34.
20. O'Donnell D, Sheiham A, Yeung KW. The willingness of general dental practitioners to treat people with handicapping conditions: the Hong Kong experience. J Royal Soc Health 2002;122:175–80.
21. Trovik TA, Klock KS, Haugejorden O. Level and predictors of agreement between patients and their dentists concerning need replacement of teeth at the time of extraction. ACTA Odontol Scand 2002;60:186–92.
22. Alonge OK, Narendran S. Opinions about oral cancer prevention and early detection among dentists practicing along the Texas-Mexico border. Oral Dis 2003;9:41–5.
23. Howells DJ, Shaw WC. The validity and reliability of ratings of dental and facial attractiveness for epidemiologic use. Am J Orthod 1985;88:402–8.
24. Hawley GM, Ellwood RP, Davies RM. Dental caries, fluorosis and the cosmetic implications of different TF scores in 14-year-old adolescents. Commun Dent Health 1996;13:189–92.
25. Chikte UME, Louw AJ, Stander I. Perceptions of fluorosis in Northern Cape communities. S Afr Dent J 2001;56:528–32.
26. Wondwossen F, Åstrom AN, Bårdsen A, Bjorvatn K. Perception of dental fluorosis amongst Ethiopian children and their mothers. ACTA Odontol Scand 2003;61:81–6.
27. King NM. Developmental defects of enamel in Chinese girls and boys in Hong Kong. Adv Dent Res 1989;3:120–5.
28. Riordan PJ. Perceptions of dental fluorosis. J Dent Res 1993;72:1268–74.
29. Riordan PJ. Specialist clinicians' perceptions of dental fluorosis. J Dent Child 1993;60:315–20.
30. Rushton VE, Horner K, Worthington HV. A two-centre study to determine dentists' agreement with current guidelines on the frequency of bitewing radiography. Commun Dent Oral Epidemiol 1996;24:175–81.

31. Tilly C, McIntosh E, Bahrami M, Clarkson J, Deery C, Pitts N. An economic analysis of implementing the SIGN third molar guideline: implications for the design and analysis of implementation studies. J Health Serv Res Policy 2005;10:143–9.
32. Pietilä T, Pietilä I. Dental appearance and orthodontic services assessed by 15–16-year-old adolescents in Eastern Finland. Commun Dent Health 1996;13:139–44.
33. Tung AW, Kiyak HA. Psychological influences on the timing of orthodontic treatment. Am J Orthod Dentofacial Orthop 1998;113:29–39.
34. Clark DC, Berkowitz J. The influence of various fluoride exposures on the prevalence of esthetic problems resulting from dental fluorosis. J Public Health Dent 1997;57:144–9.
35. Kokich VO, Kiyak HA, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. J Esthet Dent 1999;11:311–24.