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Orthodontic treatment need and oral health-related quality among children

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Objectives: To determine the association between the impact of oral health on quality of life (OHQoL) among children and their need for orthodontic treatment. ***Methods:*** Children (217) were screened for orthodontic treatment need using a number of professionally derived indices: *Index of Orthodontic Treatment Need* (IOTN) – *Aesthetic Component* (AC) and *Dental Health Component* (DHC); *Index of Complexity, Outcome and Need* (ICON) and the *Dental Aesthetic Index* (DAI). In addition, all children self-completed the 37-item Child Perception Questionnaire (CPQ), a measure of OHQoL, to assess *Oral Symptoms* (OS) experienced, *Functional Limitation* (FL), *Emotional Well Being* (EWB) and *Social Well Being* (SWB). ***Results:*** Different prevalence of orthodontic treatment need was observed depending on occlusal indices used (ranged from 31.6% to 85.9%). However, there were significant correlations between the different occlusal indices ($p<0.01$). Significant differences in overall CPQ scores existed between those with and without an orthodontic treatment need irrespective of occlusal indices used to categorize treatment need ($p<0.05$); *Effect sizes* ranged from 0.24 to 0.51. However no single index's categorization of treatment need could identify variations in all of CPQ domain scores (OS, FL, EWB and SWB). ***Conclusion:*** Different occlusal indices (AC, DHC, ICON and DAI) prescribe a different prevalence of orthodontic treatment need. Those categorized as having an orthodontic treatment need by AC, DHC, ICON and DAI criteria had poorer overall OHQoL compared to those ascribed as not having a treatment need. None of the occlusal indices could comprehensively differentiate poorer OHQoL across all its domains.

Key words: Malocclusion, occlusal indices, orthodontic treatment need, quality of life

Introduction

With the growing demand for orthodontic treatment a variety of clinician-based indices have been developed to classify various types of malocclusion and determine their orthodontic treatment need (Shue-Te Yeh *et al.*, 2000; Beglin *et al.*, 2001). Among the most commonly employed malocclusion indices are the Dental Aesthetic Index (DAI), Index of Orthodontic Treatment Need (IOTN) including the Aesthetic Component (AC) and Dental Health Component (DHC), and Index of Complexity, Outcome and Need (ICON) (Cons *et al*., 1986; Brook and Shaw, 1989; Daniels and Richmond, 2000). These have been used in prioritizing orthodontic treatment need (Shaw *et al*., 1995; Jenny and Cons, 1996).

Assessment of anatomical occlusal anomalies is thought to provide an insight into the impact of malocclusion on physical functioning. In an attempt to capture the psychosocial consequences of malocclusion on patient's lives, indices have considered assessments of the aesthetics as a proxy of such impact. DAI considers and ascribes a weighting system in calculating DAI score based on perceived aesthetic importance of various anatomical features. The weights are set-weights ascribed by a panel of lay judges and give priority for missing visible teeth and irregularities among anterior teeth (Jenny and Cons, 1996). IOTN incorporates a photographic scale (the Aesthetic Component of IOTN - AC) to assess need based on individual subject's dental aesthetics (Brook and Shaw, 1989). ICON incorporates rating on the photographic scale of AC in deriving overall ICON scores and ascribes a greater weighting for the aesthetics than any other components (Daniels and Richmond, 2000). Arguably these assessment of orthodontic treatment need based on anatomical occlusal anomalies and aesthetics impact of malocclusion do not comprehensively assess the physical, social and psychological impact of malocclusion on patients' lives; impact on quality of life (McGrath *et al*., 2004). Recently, significant advances have been made in the assessment of oral health related quality of life (OHQoL). A plethora of valid and reliable measures already exist for use among adults and promising research is emerging on the use of such a measure among children (Jokovic *et al*., 2002). This study aimed to compare the prevalence of orthodontic treatment need as prescribed by DAI, IOTN (AC, DHC) and ICON, and to examine the relationship between these indices. In addition, this study aimed to determine associations between orthodontic treatment need and oral health related quality of life.

Materials and Methods

A consecutive sample of 217 children seeking orthodontic care at the Faculty of Dentistry, The University of Hong Kong was recruited. Exclusion criteria were subjects with

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chronic medical conditions requiring use of medication, those who had received any type of orthodontic treatment, those with craniofacial anomalies such as cleft lip and palate, untreated dental caries or poor periodontal health status (presence of calculus or periodontal pockets – Community Periodontal Index grades 2 or higher) (Ainamo *et al*., 1984). The study was approved by the local ethics committee.

Subjects were asked to self-complete the Child Perception Questionnaire (CPQ), (Jokovic *et al*., 2002). CPQ consists of 37 items covering four domains: oral symptoms (OS): six items; functional limitation (FL): nine items; emotional well-being (EWB): nine items; and social well-being (SWB): 13 items. Each item is scored on a 5-point Likert scale to rate the impact of their oral health status on the particular aspect of life quality (described by the item) with responses ranging from 'none of the time' (score 0) to 'every-day or almost every day' (score 4). Overall CPQ scores can range from 0 to 148, OS scores can range from 0 to 24, FL and EWB scores can range from 0 to 36 and SWB can range from 0 to 52.

Participants' pretreatment study models were rated for orthodontic treatment need by employing different occlusal indices: IOTN (both AC and DHC components), ICON and DAI by a trained and calibrated examiner. Orthodontic treatment need was determined based on recommended threshold levels: AC category ≥8 (Brook and Shaw, 1989); DHC category ≥4 (Brook and Shaw, 1989); ICON score >43 (Daniels and Richmond, 2000); DAI score ≥31, (Cons *et al*., 1986).

Firstly, the prevalence of orthodontic treatment need was calculated based on the threshold criteria of the different occlusal indices and compared descriptively. Following on the relationship between the different occlusal indices was explored by using correlation analysis (Spearman's rank correlation). Then, CPQ scores (overall and domains scores) were derived by summating responses to items within each domain and overall scores were derived by summating domain scores. The relationship between the occlusal indices and CPQ scores was examined in correlation analysis (Spearman's rank correlation). Variations in CPQ scores (overall and domain scores) with respect to orthodontic treatment need was examined employing Mann-Whitney U tests (since data was non parametric). The magnitude of the difference in CPQ scores between those ascribed as having an orthodontic treatment need compared to those categorized as not having an orthodontic need by the various occlusal indices was assessed by calculating *effect sizes* (ES). ES = mean difference in CPQ scores between groups divided by the pooled standard deviation of scores (Cohen, 1988).

Finally, CPQ scores were dichotomised according to median values (0= median score and below; 1= above median value). Then four logistic regression analyses were conducted where the dependent variable was the dichotomised CPQ values and the independent variables were child's age, gender, parental education level and orthodontic treatment need (one index in each regression analysis). This was conducted so as to derive odds ratios to enable a comparison of the strength of the association between poor oral health related quality of life (CPQ scores above median values) and orthodontic treatment need accounting for socio-demographic factors.

Results

Five models were not amenable to occlusal analysis because of quality. Data were obtained from 212 subjects (103 were boys and 109 were girls with a mean age of 13.2 years) providing a response rate of 98%. The prevalence of orthodontic treatment differed with respect to the occlusal index criteria followed. Employing the AC of IOTN (cut off category ≥8) the prevalence of orthodontic treatment need was 31.6%. According to the DHC of IOTN (cut off category ≥4) the prevalence of orthodontic treatment need was 81.1%. The DAI (cut off score ≥31) classified 67.0% of subjects as having an orthodontic treatment need and ICON (cut off score > 43) categorized 85.9% as having an orthodontic treatment need. The correlation between the various occlusal indices is presented in Table 1. The lowest correlation was between DHC and DAI (r 0.32) and the highest correlation was between AC and ICON (r 0.84).

Correlation between CPQ scores and the occlusal indexes rating of orthodontic treatment is presented in Table 2. There was a significant correlation between overall CPQ scores and the different occlusal indices. The correlation coefficient values ranged from 0.16 (overall CPQ and DHC) to 0.27 (overall CPQ and AC). Among the CPQ domains, OS was significantly correlated with AC (r 0.25), DHC (r 0.17) and ICON (r 0.21). FL was significantly correlated with all of the occlusal indices and the correlation coefficient values ranged from 0.15 to 0.27. EWB was only significantly correlated with DAI (r 0.16). SWB was significantly correlated with all of the occlusal indices and the correlation coefficient values ranged from 0.19 to 0.26.

Children with orthodontic treatment need assessed by all indices had significantly higher scores of overall CPQ (worse quality of life) than those without orthodontic treatment need, $p<0.05$. Effect size ranged from 0.24 to 0.51 (Table 3). With respect to oral symptoms, children with orthodontic treatment need assessed by AC, DHC and ICON had significantly higher scores than those without orthodontic treatment need ($p<0.05$). Effect sizes ranged from 0.21 to 0.50. With respect to functional limitation, children with orthodontic treatment need assessed by AC, ICON and DAI had significantly higher scores than those without orthodontic treatment need ($p<0.05$); ES ranged from 0.24 to 0.64. With respect to EWB, only DAI identified significant difference between treatment need group and no treatment need group ($p=0.004$); ES ranged from 0.001 to 0.49. With respect to social well being, children with orthodontic treatment need assessed by AC, DHC, ICON and DAI had significantly higher scores than those without orthodontic treatment need ($p<0.05$); ES ranged from 0.21 to 0.42.

A summary of the findings from a series of logistic regression analyses are presented in Table 4. Children categorized as having an orthodontic treatment by AC, DAI and ICON were more likely to have a CPQ score above the median value compared to those categorized as not having an orthodontic treatment need controlling for age, gender and parental educational attainment. The odds ratios were 2.04 (95% CI, 1.11, 2.73), 2.46 (95% CI, 1.33, 4.76) and 2.82 (95% CI, 1.11, 2.73) when AC, DAI and ICON was used to determine orthodontic treatment need respectively.

Table 1. Correlation among the occlusal indices

	DHC	*ICON*	*DAI*
AC	0.37**	0.84**	0.44**
DHC		0.45**	0.32**
ICON			0.38**

Spearman rank correlation coefficient.
** p<0.01

Table 2. Correlation between CPQ and occlusal indices

	AC	*DHC*	*ICON*	*DAI*
Overall	0.27**	0.16*	0.25**	0.21**
Domains				
Symptom	0.25**	0.17*	0.21**	0.06
Functional limitation	0.25**	0.15*	0.27**	0.22**
Emotional well being	0.12	0.03	0.06	0.16*
Social well being	0.23**	0.19**	0.23**	0.26**

Values were obtained by Spearman rank correlation coefficient.
* p< 0.05, ** p< 0.01

Table 3. Comparison of mean CPQ scores between orthodontic treatment need and no treatment need groups evaluated by AC, DHC, ICON, and DAI

	AC			*DHC*			*ICON*			*DAI*		
	No need Mean (SD)	*Need Mean (SD)*	*ES*	*No need Mean (SD)*	*Need Mean (SD)*	*ES*	*No need Mean (SD)*	*Need Mean (SD)*	*ES*	*No Need Mean (SD)*	*Need Mean (SD)*	*ES*
Overall	19.7 (14.8)	24.2 (13.0)**	0.31	18.3 (15.3)	21.7 (14.1)*	0.24	14.8 (15.0)	22.1(14.0)***	0.51	16.4 (11.4)	23.4 (15.1)**	0.49
Domains												
OS	6.4 (3.4)	7.6 (3.2)*	0.35	5.7 (3.4)	7.0 (3.3)*	0.38	5.3 (3.7)	7.0 (3.3)**	0.50	6.3 (3.7)	7.0 (3.2)	0.21
FL	4.8 (4.8)	5.9 (4.2)*	0.23	4.4 (4.7)	5.3 (4.7)	0.19	2.6 (4.0)	5.6 (4.7)**	0.64	4.0 (4.3)	5.7 (4.8)**	0.36
EWB	4.2 (5.3)	5.6 (5.8)	0.25	4.7 (5.9)	4.7 (5.5)	0.01	3.4 (4.7)	4.9 (5.6)	0.27	2.9 (3.5)	5.6 (6.1)**	0.49
SWB	4.2 (4.8)	5.2 (4.9)*	0.21	3.6 (4.7)	4.7 (4.7)**	0.23	3.5 (5.0)	4.7 (4.6)*	0.25	3.2 (3.6)	5.2 (5.2)**	0.42

*p<0.05, **p<0.01, ***p<0.001
Mann-Whitney U test
ES (Effect size) = mean difference in scores between groups / pooled SD

Table 4. Summary of logistic regression analyses†

Independent variable	*B*	*SE*	*OR*	*95% CI*	*P*
Gender					>0.05
Age					>0.05
Parental education attainment					>0.05
AC	0.80	0.30	2.23	1.24, 4.04	0.008
DHC	0.64	0.37	1.90	0.93, 3.89	0.708
ICON	1.06	0.44	2.87	1.22, 6.79	0.016
DAI	0.91	0.31	2.49	1.37, 4.53	0.003

† 4 separate regression analyses, orthodontic treatment need entered as either AC or DHC or ICON or DAI

Discussion

In this study, the proportion of orthodontic treatment need as assessed by the different occlusal indices varied. This suggests that, depending on the occlusal indices employed, a different proportion will be ascribed as having an orthodontic treatment need. The proportion of orthodontic treatment need as assessed by AC was much lower than the proportion assessed by the other three indices which concurs with other reports (Tarvit and Freer, 1998; Abdullah and Rock, 2001; Fox *et al.*, 2002). Thus, there have been concerns as to what is an appropriate threshold level for AC (Kok *et al*, 2004; Abdullah and Rock, 2001).

There was a significant correlation between the various occlusal indices, although for the most part the correlation could best be described as weak-moderate with the exception being a strong correlation between ICON and AC ($r > 0.80$). This is likely to be attributed to the fact that the AC is incorporated in ICON, and that the weight ascribed for the AC is high (Jenny and Cons, 1996; Johnson *et al.*, 2000; Fox *et al.*, 2002).

There was a significant correlation between CPQ scores and the different occlusal indices, however the correlation was weak ($r < 0.30$). A previous study has reported a weak correlation between AC and overall CPQ scores (Kok *et al*., 2004). Nevertheless those ascribed as having an orthodontic treatment need (irrespective of occlusal indices employed) had poorer OHQoL (higher overall CPQ scores) than those ascribed as not having an orthodontic treatment need. The magnitude of the difference in overall CPQ scores was moderate when ICON or DAI was employed to determine those with and without an orthodontic treatment need. Thus poor oral health related quality of life and orthodontic treatment need appear to coexist in the same population. The data from the regression analysis also confirms these findings. The odds ratio of having a CPQ score above the median value was higher when ICON was used to determine the orthodontic treatment need than when AC and DAI was used to assess orthodontic treatment need.

All the occlusal indices' categorization of treatment need could differentiate poorer social well being among those with a treatment need compared to those without a treatment need. However, none of the occlusal indices categorization of treatment need could differentiate poorer OHQoL in term of all its dimensions: greater oral symptoms and functional limitation, and poorer emotional and social well being. This suggests that whilst the various occlusal indices do capture some aspects of poor OHQoL they do not comprehensively do so. Thus, it is necessary to employ an OHQoL measure (such as CPQ) when consideration is to be given to the impact of malocclusion on life quality in determining treatment priority.

Conclusion

Employing AC, DHC, ICON and DAI the prevalence of orthodontic treatment need varied. Although there was a significant correlation among them it was generally weak. Those categorized as having an orthodontic treatment need as ascribed by AC, DHC, ICON and DAI criteria had poorer OHQoL compared to those ascribed as not having a treatment need. The magnitude of the difference in OHQoL between those with and without a treatment need was largest when ICON was used to determine orthodontic treatment need. None of the occlusal indices could comprehensively differentiate poorer OHQoL across all its dimensions.

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