

Variations in treatment need using four screening methods

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The study models of 100 Grade Seven students were used to compare the Dental Aesthetic Index (DAI), the Dental Health Component (DHC) and the Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN), and the Danish Ministry of Health (DMH) screening system. The basis for comparison was the agreed subjective assessment of two orthodontists for each subject. Disagreements between the subjective assessment and each screening method were further analysed in an attempt to identify the specific occlusal traits responsible for the disagreement. The DAI under-estimated treatment need in cases with displaced canine teeth, incisor crowding or rotations and increased overbite. The DAI over-estimated treatment need in cases with increased overjet in otherwise well-aligned arches. The DMH guidelines over-estimated treatment need in cases with increased overjet and crowded arches. The DHC was found to be over-sensitive in cases with increased overjet and contact point displacements greater than 2 mm. The AC under-estimated treatment need in cases with excessive overjet and buccally displaced canines, and over-estimated treatment need in cases with spaced arches and deep overbite. Aust J Orthod 1999; 15: 214-18

Introduction

In order to facilitate comparison, epidemiological surveys require standardised methods of assessment.¹ Estimates of treatment need are based on either descriptions or measurements of various morphologic malocclusion traits,² their success dependent upon the ability of the various descriptors or traits of the malocclusion to reflect the clinical judgement of orthodontists. In this study, the authors have attempted to identify those malocclusion traits that are inadequately assessed by each orthodontic screening method.

Literature Review

The Dental Aesthetic Index (DAI) has been proposed as a screening device to determine priority for subsidised orthodontic treatment.³ Ten intraoral measurements of occlusal traits are measured and weighted, and then added to a constant to give the DAI score. The DAI links clinical and aesthetic factors to produce a single score that reflects both aspects of the malocclusion.⁴ The higher the DAI score, the further the malocclusion departs from the norm of acceptable dental appearance and the more likely the is the occlusal condition to be judged as handicapping.

The Index of Orthodontic Treatment Need (IOTN) developed by Brook and Shaw⁵ has two discrete components: the Dental Health Component (DHC) and a separate Aesthetic Component (AC). These components rank a malocclusion in terms of the effects of various occlusal traits on dental health or aesthetic impairment. The intention is to identify persons who would benefit from orthodontic treatment.⁶ The DHC grades the occlusal traits (including overjet, overbite, openbite, crossbite, displacement of teeth, and impeded eruption of teeth) according to severity, and records only the worst occlusal feature on a hierarchical scale. Each occlusal trait thought to affect the longevity and satisfactory function of the dentition is categorised, ranging from grade one (no

treatment need), to grade five (great treatment need).⁵ Unlike the DAI, minor occlusal variations are not added together to place a malocclusion in a higher category.

The AC consists of a scale of photographs representing different levels of aesthetic impairment. A rating is obtained by assessing the overall dental appearance, rather than specific morphologic similarity to a photograph. The AC score is indicative of the patient's treatment need on the grounds of aesthetic impairment and by inference reflects the psychological need for orthodontic treatment.⁶ The AC is complementary to the DHC and is intended to identify those patients for whom the psychological impact of aesthetic impairment may be an important consideration.

In 1990, the Danish Ministry of Health introduced new guidelines for orthodontic screening in Denmark.⁷ A list of the problems and sequelae that might result from a malocclusion was developed, and a list of malocclusions regarded as requiring treatment was made. The presence of any malocclusion on this list was considered to justify a full course of orthodontic treatment. The Danish system differs from previously established methods by incorporating an assessment of the health risk caused by the malocclusion.⁷ The model has been deliberately made verbal and non-numerical, and involves the use of clinical estimates.

Materials and Methods

The original sample consisted of 466 Year Seven students drawn from sixteen schools within the North Brisbane region as part of a wider orthodontic study^{8,9} for whom alginate impressions were taken with a wax bite in centric occlusion. The students were aged between 11 and 13 years. Female students (51.5 per cent) represented a slightly larger proportion of the sample than males (48.5 per cent); 95 per cent were Caucasian. For the purpose of this study, only permanent dentitions were included. Subjects who had previously received orthodontic treatment were excluded. The final sample consisted of 100 randomly selected permanent dentitions. A sub-sample of 50 cases was used to apply the screening methods; after one month this was repeated in order to test reproducibility of the principal examiner.

The study models were used to score the DAI, DHC, AC and DMH screening systems by the principal examiner. Two calibrated orthodontists, both with several years of experience in public-sector Orthodontics, examined the study models to decide whether they considered each case required orthodontic treatment. Where there was not complete agreement between the examiners, the cases were

re-examined and discussed until agreement was reached. Their decision was recorded as yes or no.

Method of Analysis

The cut-off point (threshold decision to treat) for the DAI was set at 30.5.¹⁰ For the DHC, subjects with grades three, four and five (including borderline treatment need) were included in the group requiring treatment. For the AC, grades five and above, including moderate/borderline treatment need, were included in the treatment group.

The Danish Ministry of Health guidelines state that the presence of any malocclusion on their list that poses a health risk justifies a full course of orthodontic treatment. Cases having any of the listed malocclusions that were considered to pose a potential health risk were included in the treatment group.

For each screening system, the term "the level of disagreement" was assigned to the percentage of patients whose treatment need disagreed with the orthodontists' assessment. Where there was disagreement between the orthodontists' judgement and the screening method, the individual case was examined to identify which specific occlusal traits contributed to the disagreement.

Results

Reproducibility of the Screening Systems

For the Dental Health Component (DHC), Kappa was equal to 0.96. For the Aesthetic Component (AC), Kappa was equal to 0.93. Both of these values indicate high agreement between scores. Examiner agreement between the duplicate Danish Ministry of Health assessments was calculated to be 98 per cent. The Spearman correlation coefficient was calculated for the duplicate scores of the DAI and found to be 0.97 ($p < 0.01$), indicating good agreement between scores.

The level of disagreement was calculated between each screening system and the joint subjective assessment of the two orthodontists (Table I). The comparative performances of the four indices were assessed (Table II). The DAI disagreed with the subjective assessments in 20 per cent of cases, 13 per cent being under-rated and seven per cent being over-rated. The DMH over-rated twenty-six per cent of cases. The DHC disagreed in thirty-nine per cent of cases, with thirty-eight per cent being over rated. The AC disagreed with the orthodontists in sixteen per cent of cases, with ten per cent being over-rated. The DAI was significantly correlated with the AC (0.7) and with the DHC (0.73). Individual subjects were examined to identify the reason for disagreement between the index and orthodontist (Table III). The single most frequent

Table I. Level of disagreement between the subjective assessment and the screening methods.

Level of Disagreement (%)	
DAI	20
DMH	26
DHC (Cat. 3, 4 & 5)	39
DHC (Cat. 4 & 5)	22
AC	16

DAI: Dental Aesthetic Index

DHC: Dental Health Component of Index of Orthodontic Tx. Need

AC: Aesthetic Component of Index of Orthodontic Treatment Need

DMH: Danish Ministry of Health guidelines

Cat. 3, 4 & 5: Categories 3 (borderline need),

Categories 4 & 5 included in treatment group

Cat. 4 & 5: Categories 4 and 5 included in treatment group

cause of disagreement between the indices and the orthodontists was overjet—both in under-rating and over-rating. This suggests that the degree of overjet does not always reflect the need for treatment as assessed by the examining orthodontist.

Discussion

Table II highlights a persistent comparative feature of all indices: the differences in recommendations for treatment measured by the index as opposed to the judgement of the orthodontist. For this reason, a decision for or against treatment of the individual on the sole basis of an index score will always be open to challenge. This is particularly true near the threshold value of the index; the index may result in either a positive or negative misclassification. Epidemiologically, this problem becomes less important and the index may provide a useful indication of treatment need within a population.

The DAI incorrectly classified 20 per cent of cases; of these, 13 cases were under-rated (not requiring treatment) when compared with the subjective assessment. Seven cases in this category had unsatisfactory aesthetics of upper or lower incisors due to rotation or crowding. (The weighting of one for the largest anterior irregularity may need to be increased if this occlusal condition is to be adequately evaluated.) Eight cases had upper or lower canines crowded buccally out of arch alignment; the canines are of particular importance aesthetically, and cases with this trait were included in the treatment group by the orthodontists. The results of this study suggest that subjects with malaligned canines may be under-rated by the DAI. Three cases that were under-rated had a deep overbite. According to Jenny and Cons,⁴ although overbite is not part of the DAI numerical score, abnormalities can readily be recognised by trained personnel and referred on for evaluation by an orthodontist.

Table II. Comparative two-way table of orthodontic tx. need.

		Subjective Assessment	
		No	Yes
DAI	No	63	13
	Yes	7	17
DMH	No	38	0
	Yes	26	36
DHC	No	26	1
	Yes	38	34
AC	No	58	10
	Yes	6	26

DAI: Dental Aesthetic Index

DHC: Dental Health Component of IOTN

AC: Aesthetic Component of IOTN

DMH: Danish Ministry of Health guidelines

Table III. Traits of malocclusion present where subjective assessment differed from screening system's assessment of treatment need.

		Buc Can	Ant Aes	OB	OJ	PXB	POB	ROJ	CPt Crd	Spac
DAI	Under	8	7	3	2	2	1	1	—	—
	Over	—	—	—	7	—	—	—	—	—
DM	Over	—	—	—	16	—	—	—	-7	—
DHC	Under	—	—	1	—	—	—	—	—	—
	Over	—	—	—	27	—	—	—	13	—
AC	Under	3	—	—	4	—	—	—	—	—
	Over	—	—	3	—	—	—	—	—	3

DM: Danish Ministry of Health guidelines

Under: Cases under-estimated as not requiring tx by the screening system

Over: Cases over-estimated as needing tx by screening system

Buc Can: Buccally displaced canines

Ant Aes: Unsatisfactory aesthetics of incisors due to rotations or crowding

OB: Overbite

OJ: Overjet

PXB: posterior crossbite

POB: posterior openbite

ROJ: reverse overjet

CPt Crd: Contact point displacements and crowding

Spac: Spacing

All seven cases over-estimated by the DAI had overjets greater than four millimetres; six of the seven were of five millimetres. This would suggest that the trait might be weighted too heavily. Six of these seven cases had DAI scores of 31 or 32, indicating that they were borderline treatment cases. A slightly higher cut-off point of 32.5 as used by Keay *et al.*¹¹ may be more appropriate; this would mean that moderately increased overjets in otherwise well-aligned arches would not be included in the treatment group. One advantage of the DAI is that a detailed description of the patient's malocclusion is recorded and, if study models are not available, may be reviewed in the absence of the patient.

Obvious limitations exist in applying the Danish Ministry of Health screening system to this research, as only study models were used. The DMH guidelines over-rated treatment need in 26 per cent of cases. Sixteen of these cases had increased overjet. Judging the importance of this trait is difficult without clinical examination of the patient's face; this is particularly so in cases that are borderline. Determining a numerical cut-off point above which overjet poses a health risk is impossible. Seven cases that were over-rated had crowding present. The inclusion of these cases in the treatment group may be a valid judgement if it is considered that a health risk is posed by excessive crowding. In addition, the DMH guidelines take into account the fact that a malocclusion requires treatment in the future if the condition worsens.

The DMH screening system is subjective and relies on the judgement of a specialist to assess any health risk posed by the malocclusion. As the DMH system has no predetermined cut-off points,⁷ it is less likely to exclude those in need of treatment, as compared to an index relying on numerical measurements of occlusal traits. It may be unsuitable for use by auxiliary staff and general practitioners, as a considerable knowledge of health risk and future complications of untreated malocclusions is required.

For the DHC of the IOTN, the level of disagreement with the subjective assessment of the orthodontists was 39 per cent. Of these, 38 were over-rated by the DHC. Twenty-seven cases had excessive overjet (greater than 3.5 millimetres) and 13 had contact-point displacements greater than two millimetres. Displacement of contact points greater than two millimetres but less than or equal to four millimetres are categorised as grade three (borderline need). Accordingly, any contact point displacement in this range in an otherwise acceptable occlusion is included in the treatment group. If the cut-off point is moved to a higher level on the DHC scale (between grades three and four) so as to exclude borderline need cases, the level of disagree-

ment of this sample drops to 22 per cent. So and Tang¹² found that the DHC puts heavy weights on missing teeth, and on tooth displacements. When the DHC is used on casts, crossbites also are assumed to be associated with mandibular displacement.

According to Jenny and Cons,⁴ the importance of missing teeth is rated differently by the DAI and the IOTN. Using the DHC, one missing tooth, when judged to be the worst trait, is graded as definitely needing treatment. The DAI gives one visible missing tooth a weight of six; if this were the only trait recorded, then the score would be low and be judged by the DAI as not requiring treatment. Furthermore, the DHC lacks the ability to rank order cases with greater or lesser need for treatment within grades, unlike the DAI, which ranks scores according to a continuous scale.

Compared with the subjective assessments of the orthodontists, the level of disagreement for the AC was 16 per cent (16 out of 100 cases). Of these, six were over-rated by the index as requiring treatment. In this group, three cases had spaced arches and a deep overbite. Of the ten cases under-rated by the index, four had excessive overjet. Three of the ten had canines that were crowded out of the arch. In this study, the AC scale did not adequately reflect these traits. Difficulty arises in trying to match the malocclusion to frontal photographs, in borderline cases in particular.

Conclusions

The DAI was shown to under-estimate treatment need in malocclusions with displaced canines, deep overbite and unsatisfactory aesthetics of the anterior teeth due to incisor rotations. It tended to over-estimate treatment need in cases with increased overjet in otherwise well-aligned arches. This index has the advantage of being simple to use and requires less knowledge of occlusal traits than the Dental Health Component.

The Danish Ministry of Health guidelines over-estimated treatment need in cases with increased overjet and crowded arches. This method is subjective and relies on the judgement of an orthodontist to assess health risk posed by the malocclusion. It is less likely to exclude those in most need of treatment than an index relying on numerical measurements of occlusal traits. It would be unsuitable for use by auxiliary staff because a great deal of knowledge of health risk and the outcomes of untreated malocclusions is required.

Extensive knowledge of ten occlusal traits is necessary for the scoring of the DHC. This may limit its use by anyone other than an orthodontist and thus its usefulness in a public health environment may be

limited. In addition, this classification system was found to over-rate cases with increased overjet and contact point displacements of greater than two millimetres in otherwise well aligned arches.

The AC was found to under-estimate treatment need of some cases with excessive overjet and buccally displaced canines. It both under-estimated and over-estimated treatment need, suggesting that the use of frontal photographs to assess treatment need is inadequate in some cases.

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