

# A new method of measuring how much anterior tooth alignment means to adolescents

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**SUMMARY** The aim of this study was to develop an instrument to measure an individual's value of the appearance of their anterior teeth. Structured interviews were carried out using the Index of Orthodontic Treatment Need (IOTN) as a basis for time trade-off and visual analogue utility measurement. The subjects of the study were forty-five 11–14-year-old children at new patient consultation with an orthodontist (seekers) and forty-five 11–14-year-old children in school (non-seekers)

It was possible to derive utility values using the techniques adopted. The seekers and non-seekers of treatment had significantly different utility values for anterior tooth appearance ( $P < 0.05$ , Mann–Whitney).

This study suggests that it is possible to develop utilities that reflect how patients value the appearance of anterior teeth. These utilities had a predictive validity in that there were significant differences in seekers' and non-seekers' utility values. The seekers placed a higher value than non-seekers on the desirability of a good aesthetic appearance.

## Introduction

The aim of this investigation was to develop an instrument to measure the value that individuals place on the appearance of their anterior teeth.

### *Measurement of orthodontic need and outcome*

Over the past few years a great deal of work has been carried out to develop valid and reliable measures of orthodontic treatment outcome and need, predominantly using occlusal indices (Cons *et al.*, 1986; Shaw *et al.*, 1991a; Espeland *et al.*, 1992). However, when the relationship between these measures and the patients' perception of their orthodontic status, quality of life, and uptake of treatment are considered, it would seem that such indices are failing to capture the subjective dimensions of health that reflect the patients' values.

Therefore, consideration should be given to the possibility of using existing socio-dental measures, such as the Oral Health Impact Profile (Slade and Spencer, 1994). Unfortunately, while these measures appear to be valid for other

dental disorders, they also include items that measure features such as pain, discomfort, and difficulty in chewing. As a result, they are not particularly useful for orthodontic problems, which are generally related to appearance. Furthermore, because most orthodontic 'conditions' are asymptomatic, any instrument should concentrate on factors such as values, attitudes, and feelings about appearance.

### *Utilities*

Utility measurement is generally accepted as being the method of choice when attempting to place a 'value' on a given state of health or when there is a deviation from normal. While utility studies have been carried out for other areas of dentistry (Fyffe and Kay 1992; Brickley *et al.*, 1995), no investigation has been undertaken to examine the utility derived for orthodontic treatment.

Utilities are cardinal values assigned to health status. In essence, a utility value is a number that, in theory, represents a condensation of the

biological, physical, sociological, and psychological parameters that influence a person's sense of well being. The use of utilities moves us away from the biomedical model of 'health' and 'disease' towards a view that patients' personal feelings and desires are an integral part of health care decisions. Utilities are, therefore, of particular relevance where treatment (i.e. orthodontics) is not aimed solely at resolving or removing pathology, but instead aims to improve the care-seeker's quality of life.

Well-researched methodologies are available for the measurement of utilities. Most are based on the premise that individuals are able to make judgements about the effect which a given state of health (or in this case malocclusion) would have on their lives. The time trade-off (TTO) and standard gamble methods of utility measurement also allow the individual to make judgements about the comparative worth of various relevant health states.

The TTO technique for measuring the utility of health states has been shown to be acceptable, reliable, and responsive, and gives comparable results to the standard gamble technique for measuring health state utilities (Torrance, 1986). Most importantly, it is considered to be easier for the general public to understand (Eraker and Sox, 1981).

Utility measurement involves the respondents making value judgements about their preference for worst, best, and intermediate health states. In medical fields, the worst health outcome is generally 'death' and the best 'perfect health'. However, research has shown (Llewellyn-Thomas *et al.*, 1982) that when using these techniques the 'worst health outcome' used should be presented as the worst case scenario in relation to the clinical situation considered, rather than death, when it is not a related construct. As a result, 'death' and 'perfect health' were not used as anchors in this study, since to do so would be highly inappropriate. This problem has been addressed by other oral health decision theorists. For example, Torrance (1976) stated that, when developing utilities for measuring health states, the items chosen for inclusion should relate to the primary purpose of the research.

## Aims

In orthodontics, the possession of a malocclusion does not seem to act as a major predictor of decisions to seek care (Shaw *et al.*, 1991b). This observation leads to the question, 'Do non-seekers simply not perceive any problem with their malocclusion, or do they perceive their teeth in the same way as seekers, but simply make different judgements about the most appropriate action to take?' In order to examine this concept, an investigation was carried out to elicit patient-based utility values for anterior tooth appearance.

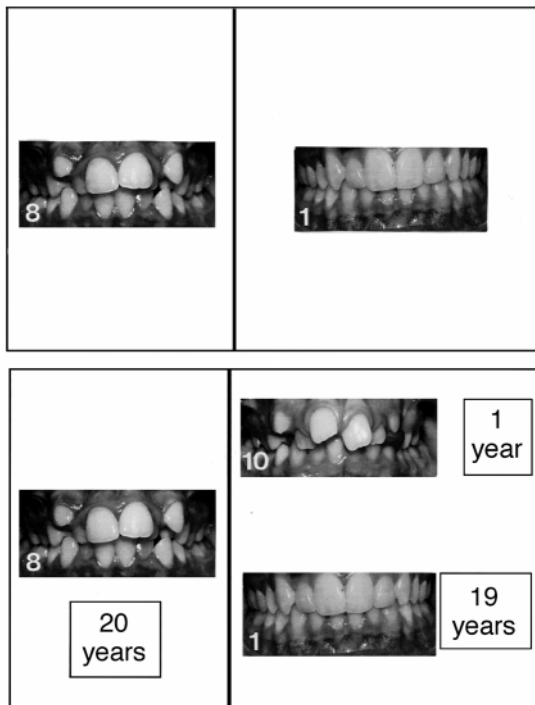
## Methods

### *Sampling*

A sample of 90 children aged 11–14 years were included in this study and 45 were referred for orthodontic treatment by their dentists. The other 45 were children who had not sought treatment. These children were sampled using random number tables from grades 6 and 7 of a local school. Any children who were receiving or were on a waiting list for orthodontic treatment were excluded from the sampling process.

### *Development of data collection material*

Utility values were measured using the TTO and visual analogue techniques. In order to do this, a visual method of data collection that was based on the Aesthetic Component (AC) of the IOTN (Brook and Shaw, 1989) was developed. This was constructed using a blue card base that was divided into two parts. On the left-hand side a colour photograph of the intermediate AC score to be assessed (3, 5, or 8) was placed in the middle of the section with the caption '20 years' positioned underneath. The right-hand side of the display contained a photograph of IOTN AC 10 at the top and grade 10 at the bottom. Directly, across from these pictures were the captions 1 and 19 years. This time scale, part of the instrument, comprised a number of 'flip cards', so that the options of the years could be changed (Figure 1).



**Figure 1** The pictures used to calculate the subjects' utility values.

### *Visual analogue scale*

A VAS 200 mm long using anchor points of AC scores 1 and 10 was constructed.

### *Data collection*

Each subject underwent an interview that involved the following components:

- (1) eliciting utility scores for AC 3, 5, and 8 using the time trade-off technique and the VAS;
- (2) scoring their own IOTN AC, and measurement of the DHC and AC of the IOTN by the interviewer.

### *Collection of utility scores*

Each subject was seated beside the interviewer, and shown the instrument with the two pictures of AC 8 and AC 1 side by side (Figure 1) and then told 'I want you to imagine that you could have your teeth looking like this or this (pointing at the two pictures), which would you prefer'.

The child would then indicate their preference. The questionnaire chart was then flipped over to reveal a picture of AC 8 with 20 years written underneath on the left-hand side. The right-hand side contained pictures of AC score 10 with a sign showing 1 year and AC 8 with a sign showing 19 years. The subject was then told the following 'You have two choices here. The choice on the left side is to have your teeth looking like this (AC 8) for the next 20 years OR, 1 year with your teeth looking like this (AC 10) plus 19 years with your teeth looking like this (AC 1). Given the choice which side would you want?' If the subject indicated the right-hand side, the chart was then flipped so that the pictures stayed the same, but the choice was now either the next 20 years with appearance AC 8, or the next 20 years with 2 years of AC 10 and 18 years of AC 1. This procedure was then continued until the subject would not trade-off any more years and would accept 20 years with the appearance of AC 8. A record was made at what stage the subject reached this point.

The process was repeated for AC scores 3 and 5 on the left side.

When the subject had completed this part of the interview they were then shown the VAS and told: 'Here is a scale with nice teeth at the top and horrible teeth at the bottom. I want you to look at this picture (they were shown AC 8) and mark with a cross on the scale where you think that these teeth should go on the scale.' The subject then made a cross on acetate that overlaid the VAS. The procedure was then repeated for AC scores 3 and 5.

### *Reliability*

Ten subjects were tested 7 days later with a second interview to evaluate test-retest reliability.

### *Statistical analysis*

Standard descriptive statistics were generated and tested for normality. As the data were not normally distributed they were analysed using the Mann-Whitney and Spearman's tests. Intra-examiner agreement for IOTN was analysed using the weighted Kappa statistic.

## Results

The total sample comprised 43 boys and 47 girls with a mean age of 12.5 years (range 11.0–13.9 years). There were no differences between the ages and genders of the seekers and non-seekers of treatment ( $P > 0.05$ , Mann–Whitney).

### *Index of Orthodontic Treatment Need*

Tables 1–3 contain the frequency distributions of the subjects' AC scores (as scored by the examiner and themselves) and the DHC scores (by examiner).

It can be seen that the non-seekers had a lower need for treatment than the seekers, according to both the DHC and AC of IOTN ( $P < 0.005$ ). When the subject's own AC scores were analysed, they were higher than the score given by the examiner. Most of the subjects placed themselves in the 1–4 category (little or no need for treatment). These scores were not different between the seekers and non-seekers ( $P > 0.05$ , Mann–Whitney).

### *Utility values*

Table 4 shows the data for utility values as calculated by the TTO and VAS methods.

Data analysis revealed that the seekers of treatment, using the TTO technique produced statistically significant lower utility values for AC 5 and 8 than non-seekers ( $P < 0.05$ , Mann–Whitney). Otherwise there were no differences between the groups.

**Table 1** Distribution of AC grades as scored by the examiner.

AC score	Seekers	Non-seekers
1–4	14 (31.1%)	36 (80%)
5–7	9 (20%)	7 (15.6%)
8–10	22 (48.9%)	2 (4.4%)

**Table 2** Distribution of AC grades as scored by the subjects.

AC score	Seekers	Non-seekers
1–4	33 (73.3%)	41 (91.1%)
5–7	5 (11.1%)	2 (4.4%)
8–10	6 (13.3%)	2 (4.4%)

**Table 3** Distribution of the DHC scores of IOTN.

DHC score	Seekers	Non-seekers
1–2	1 (2.2%)	30 (66.7%)
3	11 (24.4%)	6 (13.3%)
4–5	33 (73.3%)	9 (20%)

### *The association between utilities and aesthetic appearance*

The subjects' and examiners' AC scores, and the utility values derived from both techniques were then evaluated to determine any association.

**Table 4** The utility values calculated for the seekers and non-seekers of treatment using the time trade-off and visual analogue techniques for aesthetic component grades 3, 5, and 8.

	Aesthetic component score	Seekers	Non-seekers	P-value
Time trade-off	3	0.92 (0.14)	0.95 (0.12)	0.183
	5	0.69 (0.30)	0.87 (0.18)	0.001
	8	0.55 (0.35)	0.74 (0.30)	0.004
Visual analogue	3	0.75 (0.17)	0.75 (0.15)	0.698
	5	0.54 (0.16)	0.48 (0.17)	0.102
	8	0.28 (0.15)	0.32 (0.16)	0.260

**Table 5** Results of test-retest reliability.

	Reliability (Kappa)	Lower 95% CI
TTO 3	0.78	0.46
TTO 5	0.92	0.77
TTO 6	0.91	0.75
VAS 3	0.67	0.26
VAS 5	0.69	0.28
VAS 8	0.63	0.19

TTO = time trade-off; VAS = visual analogue.

No strong associations were found ( $P > 0.05$ ; Spearmann's correlation).

#### *Test-retest reliability*

The results of the test-retest reliability are shown in Table 5.

The data analysis reveals that the TTO technique appears to be more reliable than the VAS technique.

### **Discussion**

The main objective of this investigation was to ascertain whether it was possible to derive patient-based utility values for the appearance of anterior teeth. It appears that this was the case. Furthermore, the utility values derived appear to have predictive validity, as there were significant differences in the values obtained from seekers and non-seekers of treatment. These results are an important beginning in identifying personal perceptions of the value of orthodontic treatment.

#### *The nature of the sample*

It is not surprising that seekers of treatment had a greater need than the non-seekers and suggests that the sample is valid for this type of research. The results show that 20 per cent of the non-seekers demonstrated a normative need for orthodontic treatment. It is therefore assumed that they were satisfied with their occlusion and this adds weight to the hypothesis that consumer values are as important as normative measures.

It was also noteworthy that all the subjects rated their own aesthetic appearance at the more attractive end of the AC scale than the examiner. These findings agree with other studies that concluded that the dental aesthetic ratings of orthodontists were less favourable than of children. This emphasizes the need for patient-based measures of aesthetic treatment need.

#### *The derivation of the utility values*

The results suggest that it is possible to develop utility values for anterior tooth appearance and these values have a degree of validity. Furthermore, the methods of data collection were successfully carried out, in that all the children could co-operate and the interview was not lengthy. It is important to recognize that the numerical utility values acquired relate only to anterior tooth alignment. It is not being suggested that orthodontic utilities are in any way comparable to general health state utilities.

#### *Differences between seekers and non-seekers*

The most important finding of this investigation was that the utility values that were derived were different between seekers and non-seekers of orthodontic treatment. This leads us to explore the idea that both seekers and non-seekers of orthodontic treatment, when faced with a series of photographs of anterior tooth appearance recognize aesthetic appearance in the same manner (demonstrated by the fact that both groups gave similar utility scores using the visual analogue scale). However, when the differences detected using the TTO technique are taken into account, it appears that although both seekers and non-seekers of orthodontic treatment 'see' a particular tooth appearance in the same way, seekers of orthodontic care place a higher value on a good aesthetic appearance.

#### *Comparison of utility values of subjects and AC of IOTN scores*

It was also interesting to find that there were no associations between utility values, and the subjects' and examiners' AC scores. This suggests

that aesthetic tooth appearance influences the value that individuals place on aesthetic tooth appearance. As a result, a particular tooth appearance has an inherent value to a given individual, whether or not their teeth are maligned.

This reinforces the concept that other factors influence an individual's decision regarding the desirability of a certain anterior tooth appearance (Shaw *et al.*, 1991b). This is also evident from clinical appearance, as most orthodontists have experienced prospective patients who have great concern over minor anomalies and, conversely, patients who are not concerned by a severe malocclusion. Whilst this variation has been recognized for many years, a method of capturing and quantifying the factor which determines treatment acceptance has never previously been demonstrated.

If we take this concept a little further, what the individual sees when they look at their anterior tooth appearance may not be what drives them to seek orthodontic treatment. This may be a reflection that, within their own family and social groups, they have achieved a level of personal satisfaction with their appearance. Consequently, an improvement from orthodontic treatment would not increase quality of life to any worthwhile degree.

#### *The use of utilities in orthodontics*

Over the past few years there have been many developments in the measurement of the outcome of orthodontic treatment, for example, occlusal index scores or cephalometric measurement. One criticism of these measures is that they do not seem to reflect an important aspect of orthodontic treatment, i.e. whether the patient feels driven to change the appearance of their teeth. This study shows that orthodontic patient utilities could be incorporated into the other measures that are already used, for example, the IOTN.

Another use may be to incorporate utilities into a decision analysis model that aids a patient to obtain evidence-based consent for certain orthodontic treatment methods. For example, difficult decisions regarding the risk/benefit equation for the treatment of mild malocclusion

could be helped if the individual's own utility value for anterior tooth appearance is known.

Finally, utilities may be incorporated into a measure that could predict a patient's co-operation with orthodontic treatment. This could possibly be in the form of computer programmes that guide the prospective patient through the TTO process. Such an instrument could provide highly useful information if it formed part of the initial patient assessment. It is not unreasonable to suppose that a prospective patient who places a high value on aesthetic tooth appearance may co-operate well with treatment, whereas those with lower utilities would be less 'driven' to participate in treatment and it would be useful to identify this group before treatment commences. However, this requires further investigation.

#### *Limitations of the present study*

The results of this investigation are limited to the subjects involved, i.e. children between the ages of 11 and 14 years of age, resident in the North West of England. It could be suggested that these values might differ between geographical areas of the UK and other countries. However, the findings certainly provide a basis for further work in other parts of the UK and the world.

#### **Conclusions**

The findings of this study show that it is possible to develop utilities that reflect patient's values of the appearance of anterior teeth. These utilities have a degree of validity in that they were different between seekers and non-seekers of orthodontic care. The seekers placed a higher value than non-seekers on the value of a good aesthetic appearance.

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