

# Providing a Numerical Measure of Oral Health – Can it be Done and How Accurate is it?

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**Abstract:** An Index of Oral Health (OHX) was developed by Burke and Wilson<sup>1</sup> in the mid 90s. Use of the index involves assessing patient comfort and satisfaction in addition to the assessment of caries, periodontal disease, toothwear, mucosa, occlusion and dentures, where appropriate. On completion of this structured examination, the clinician arrives at an overall oral health index (OHX) for the patient, which is expressed as a fraction of the maximum achievable score.

The index was modified by Denplan UK by amending the calculations to produce the Oral Health Score (OHS).

The Reproducibility of the OHX and OHS was tested at Birmingham Dental Hospital and School during 2001 and 2002 and was found to be satisfactory. The dentists' opinions on the OHX and OHS were assessed by means of questionnaires. Most of the dentists felt that both were easy to use.

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**Clinical Relevance:** A measure of Oral Health would provide the practitioner with a means of measuring the effectiveness of treatment and of improving communication with patients.

## MEASURING ORAL HEALTH

A means of measuring oral health is necessary for the purpose of audit, clinical governance and healthcare management. It may also be used as a means of patient motivation. In order for an instrument to be accepted for universal use, it must be valid, easy to use and involve a minimum of equipment and time. At present, no valid and reproducible measure of oral health is used in the assessment of patients treated under NHS regulations.

In the document *An Oral Health Strategy for England*, the Oral Health

Strategy Group defined oral health as:<sup>2</sup>

*A standard of health of the oral and related tissues which enables an individual to eat, speak and socialize without active disease, discomfort or embarrassment and which contributes to general well-being.*

It would therefore be appropriate for an instrument to be designed to measure oral health, incorporating a clinical component and also a patient satisfaction component.

## COMPOSITION OF THE ORAL HEALTH INDEX (OHX)

The OHX<sup>1</sup> comprises components representing the presence/absence of caries, adequacy of restorations, condition of mucosa, occlusal

assessment, denture assessment, presence/absence of toothwear, calculus and pocketing in excess of 3.5 mm. Patient function and satisfaction components are also included.

The OHX utilizes a score of zero or one for each tooth assessed for its 'restorative status' in a manner similar to Anaise and Ehrlich,<sup>3</sup> with scores of zero or multiples of one for the other sections. A total score of 15 is achievable in the patient satisfaction component, 10 in the occlusal component and 5 for mucosa. Wear, periodontal examination and the presence of subgingival calculus are assessed per sextant. A maximum score of one per sextant is possible for each of these components. Each of the denture components is scored out of 5. No intermediate score is attainable in any section, that is, each item assessed is either acceptable (positive score) or unacceptable (zero score). For example, from the viewpoint of restorative status, any tooth which is considered carious or contains a defective restoration is awarded a zero score, and a sound tooth or restored tooth in which the restoration is deemed satisfactory achieves a score of one. In this way, oral health rather than various disease states are viewed and scored positively rather than negatively.

Previously accepted standards and/or indices are used to comprise the various elements of the index. Among these are the Adult Dental Health Survey criteria for caries,<sup>4</sup> the clinical acceptability of restorations as defined by Ryge<sup>5</sup> and the Faculty of General Dental Practitioner's self assessment manual,<sup>6</sup> toothwear as defined by Smith and Knight<sup>7</sup> and periodontal status as measured by the

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Community Periodontal Index of Treatment Needs (CPITN).<sup>8</sup> Acceptable mucosal health is defined by previously recognized criteria. With regard to occlusal function, it has previously been considered that ten opposing teeth may be adequate for masticatory function,<sup>9</sup> and patients are scored accordingly. When dentures are present, the adequacy of the dentures is assessed by examining their retention, stability and freeway space, where appropriate. Patient comfort and satisfaction are measured from the responses to three questions.

The examination for the OHX is completed in the following sequence.<sup>1</sup>

### PATIENT SATISFACTION

The patient is asked to respond to three questions:

- Is your mouth free from pain?;
- Can you comfortably chew an unrestricted diet?;
- Are you happy with the appearance of your teeth?

For each question a response of YES will score 5, a response of NO will score zero (Figure 1).

### ASSESSMENT OF STANDING TEETH

#### Assessment of Caries

A tooth is considered to be decayed (and hence would achieve a zero score) if, in the opinion of the examiner, after visual examination, there is clinical caries present with enamel breakdown. In respect of root surfaces, active carious lesions may be considered to be yellow/orange, tan or light brown in colour. Arrested carious lesions tend to be dark, almost black in colour, and may be considered sound and allocated a score of one.

#### Assessment of Restorations

A restoration is considered to be unsatisfactory if:

- Either dentine or base is exposed at the margin of the restoration and if an area of discontinuity is present between tooth and restoration into which a periodontal probe tip will pass. In the case of a crown, this is similarly interpreted.
- The restoration is fractured or mobile, where caries is contiguous with the margin of the restoration.
- The contour of the restoration is unsatisfactory.

Factors such as a deficient contact, inadequate marginal ridge form, or gingival excesses fall into this category. Similar criteria apply to crowns. A sound tooth/satisfactorily restored tooth will achieve a score of one, while a tooth in which the restoration is deemed to be unsatisfactory, or in which caries is present, is awarded a zero score in this section of the assessment.

#### Tooth Fracture

Where tooth structure is fractured with dentine exposed, the tooth will be awarded a zero score in this section of the assessment.

#### WEAR ASSESSMENT

Wear is assessed by examination of all the surfaces of the teeth and is scored in sextants. Where more than one-third of the enamel has been lost on either the buccal, lingual or occlusal surfaces, or where enamel was lost with dentine exposure incisally, resulting in a negative contour, or where there is a cervical defect of more than 2 mm in depth of any tooth in a sextant, the sextant is given a score of zero. Where teeth in a sextant are worn to a lesser extent, or do not exhibit any wear, a score of one is awarded to that sextant.

#### PERIODONTAL ASSESSMENT

The periodontal assessment is carried out by means of a CPITN probe.

- Each tooth is examined for sub-gingival calculus and a score is

given in sextants. Absence of calculus results in a score of one being given for that sextant, while the presence of such calculus on any tooth in a sextant leads to a zero score being given.

- A CPITN value at each sextant is determined. A CPITN score of 0–2 results in a score of 1 being awarded for that sextant, while a CPITN score of greater than 2 at any site in a sextant leads to a zero score for that sextant.

### OCCLUSAL ASSESSMENT

The occlusal state is assessed with dentures in position, if these are worn by the patient. The presence of ten or more natural or denture teeth opposite each other (in the intercuspal position) achieves a score of 10; fewer than ten teeth opposing each other results in a zero score.

### MUCOSAL ASSESSMENT

The examination of the oral mucosa includes all surfaces of the tongue, the floor of the mouth, hard and soft palates and lip and cheek mucosa. Healthy mucosa is given a score of 5, while the presence of any pathology, other than that which is considered to be of a transient nature (such as aphthous ulceration), results in a score of zero. Examples of the mucosal diseases which would lead to a zero score for this section are chronic or progressive lesions such as candida infections, angular cheilitis, bullous lesions, leukoplakia, hairy leukoplakia, lichen planus or denture stomatitis. The presence of a discharging sinus will also result in a zero score in this section. Lesions such as Kaposi's Sarcoma or suspected oral carcinoma, which require referral for specialist opinion and treatment, will result in a score of 'R' being awarded for the overall OHX assessment, to indicate that an OHX value cannot be made without referral for further examination.

### DENTURE ASSESSMENT

Dentures are assessed for each of

three qualities:

- The presence of a clinically acceptable freeway space (i.e. more than 2 mm but less than 7 mm) achieves a score of 5.
- Adequate retention and stability achieves a score of 5.
- Dentures in satisfactory condition achieve a score of 5. The presence of deposits on a denture, excessive wear or cracks leads to a zero score.

### Edentulous Patients

The proposed OHX may also be used for assessment of patients who are edentulous, by completion of the patient satisfaction component, the denture-related assessments, the occlusal state and mucosal state sections. It is possible for an edentulous patient to achieve an OHX of 100 and it is also possible for a dentate patient to achieve a low OHX. Dental status and oral health are separate concepts and should be assessed separately. Dental status is defined as a function of the number of pairs of opposing teeth, and the proportion of teeth restored or requiring restoration.

### Overdenture Abutment and Transmucosal Implants

These are assessed using the same criteria as are applied in the assessment for caries, assessment of restorations and periodontal sections.

### CALCULATION OF OHX VALUE

Having completed the various assessments, the Oral Health Index (OHX) value is determined by adding together the scores recorded and by dividing the total score by the maximum score possible for the sections included in the assessment.

It was considered that the index may have greater impact if expressed as a percentage, with the value falling with decreasing levels of oral health. Improvements in oral health during a course of treatment are reflected by increases in the OHX score.

### Development of the Denplan Oral Health Score (OHS®)

The scoring system of the OHX was modified by Denplan UK (Winchester), a company which operates a private dental capitation scheme, by changing the percentage calculations to subtractions, to produce the Oral Health Score (OHS).<sup>10</sup> Denplan UK have incorporated the OHS into their 'Excel' quality assurance programme, which requires practitioners to provide their patients with regular Oral Health Scores.

### Reproducibility and Acceptability of the Oral Health Index and the Oral Health Score

To test the reproducibility of the OHX and OHS in clinical practice, a group of GPs were recruited and asked to examine patients using their own method of examination and also using the structured format of the OHX and OHS examinations. Estimates of both inter- and intra-examiner reproducibility were calculated for all three examination methods.<sup>11,12</sup>

#### Inter-Examiner Reproducibility

Higher inter-examiner reproducibility was achieved when the structured format of the OHX was used rather than the dentists' own method. The inter-examiner reproducibility for the OHX ranged from 51–93%, suggesting that, on average, the reproducibility of the OHX is fair to good. The inter-examiner reproducibility for the Dentists' Own Score, by comparison, ranged from 41–88%, lower than that for the OHX. Good inter-examiner reproducibility was demonstrated for the OHS with agreement ranging from 70–95%.<sup>11,12</sup>

#### Intra-Examiner Reproducibility

Out of 20 dentists, 17 had higher reproducibility using the OHX than the Dentists' Own Score. The intra-examiner reproducibility for the OHX was excellent, ranging from 75–97%. Out of 10 dentists, 7 had higher reproducibility when using the OHS than their own scoring method. Intra-examiner reproducibility for the OHS ranged from 81–97%.

### Dentists' Opinions on the OHX

Ten dentists were involved in assessing the reproducibility of all three methods of examination. These ten dentists were then asked their opinions on the OHX.

Three of the dentists commented that the weightings required some adjustment but did not specify which components required adjustment of weightings.

Appropriateness of the weightings aside, the other two main criticisms of the OHX were the difficulties with the calculations and the time taken to complete an OHX examination (Figure 1). The time to complete an examination was recorded by the dentists on the patient assessment forms. The dentists spent, on average, 7 minutes on the Dentists' Own Scores and, on average, 8 minutes on the OHX. There was no evidence to suggest that using the structured OHX assessment took much longer than the dentists' own method of examination.

The dentists were asked to rate the OHX for ease of use from 1 to 5 where 5 is easy to use and 1 is difficult. Two of the dentists scored the ease of use as 5, six as 4 and two as 3. Nine said that they had to complete between 3 and 5 examinations before becoming accustomed to using the index, and only one needed to complete between 10 and 20 examinations in order to become familiar with the index.

The dentists indicated that the OHX could have the following applications in order of preference:

- Audit;
- Education;
- Patient motivation and research;
- Clinical governance and marketing;
- Peer review and epidemiology.

### Dentists' opinions on the OHS

Denplan UK also commissioned a survey among their dentists on the ease of use and their understanding of the OHS.<sup>13</sup> The majority of respondents found the OHS to be easy to use and a valid representation of a patient's oral health.

### DISCUSSION

Adoption of a scoring method appropriate to general practice is of

more relevance today than when the original paper on OHX was first published,<sup>1</sup> given the need for clinical governance. The reproducibility studies on the OHS and OHX highlight that the overall reproducibility of General Dental Practitioners is improved by using the structured format of these examinations. In fact, Ireland and co-workers found that there was an improvement in the quality of clinical record keeping of a sample of 50 dentists piloting the Denplan Excel scheme,<sup>14</sup> again providing further evidence that following a structured examination sequence improves consistency. The inter-examiner reproducibility of the OHS is good, and of the OHX is fair. Therefore, before the OHX can be adopted for epidemiology or comparing practices, further training of general practitioners is required. It is suggested that two hours of training would enable practitioners to understand the rationale of the OHX and allow them time to familiarize themselves with the examination sequence. The intra-examiner reproducibility of the OHX and of the OHS is excellent, and both will give the practitioner an easy-to-use tool providing a measure of how successful he/she is in providing and maintaining optimum oral health for patients. This may have advantages both in enhanced patient care and in more cost-effective use of resources and it may enable the practitioner to feel that he/she is carrying out a useful role in the holistic care of the patient. This in turn may enhance his/her professional satisfaction and thereby provide even greater opportunities for improving patient care.

REFERENCES

- Burke FJT, Wilson NHF. Measuring oral health: an historical view and details of a contemporary oral health index (OHX). *Int Dent J* 1995; **45**: 358-370.
- Oral Health Strategy Group. *An Oral Health Strategy for England*. London, Department of Health, 1994.
- Anaise JZ, Ehrlich J. A method for recording and numerically scoring quality of dental restorations. *J Public Hlth Dent* 1977; **37**(1): 57-61.
- Adult Dental Health Survey: Oral Health in the United Kingdom, 1998*. Appendix C.1. London: HMSO, 2000.

- Ryge G. Clinical criteria. *Int Dent J* 1980; **30**: 347-357.
- Advisory Board in General Dental Practice. *Self-Assessment Manual and Standards*. London, Royal College of Surgeons of England, 1991.
- Smith BGN, Knight JK. An index for measuring the wear of teeth. *Br Dent J* 1984; **156**: 435-438.
- Ainamo J, Barnes D, Beagrie G, Cutress T, Martin J, Sardo-Infirri J. Development of the World Health Organisation (WHO) Community Periodontal Index of Treatment Needs (CPITN). *Int Dent J* 1982; **32**: 281-291.
- Witter DJ, Cramwinckel AB, van Rosum GMJM, Kayser AF. Shortened dental arches and masticatory ability. *J Dent* 1990; **18**: 185-189.
- Matthews R, Busby B. The Oral Health Score. *The Dentist* 2001; **17**(7): 48-50.

- Delargy S, McHugh S, Hall AC, Burke FJT. Reproducibility of an Index of Oral Health among General Dental Practitioners. *Pan European Division of IADR* 2002; September: 416.
- Busby M, Delargy S, McHugh S, Matthews R, Burke FJT. Reproducibility of An Oral Health Score in General Practitioners. *Pan European Division of IADR* 2002; September: 417.
- Burke FJT, Busby M, McHugh S, Delargy S, Mullins A, Matthews R. Evaluation of an oral health scoring system by dentists in general dental practice. *Br Dent J* 2003; **194**(4): 215-218.
- Ireland RS, Harris RV, Pealing R. Clinical record keeping by general dental practitioners piloting the Denplan "Excel" accreditation programme. *Br Dent J* 2001; **191**: 260-263.

**OHX EXAMINATION FORM** DATE .....

PATIENT'S NAME ..... Sex ..... Age .....

M = Missing (inc. Pontic)  
1 = Sound or Filled  
0 = Decayed or unsound

18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	21	22	23	24	25	26	27	28		
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38												

  

<table border="1" style="border-collapse: collapse; width: 100%;"> <tr><td style="width: 33%; height: 40px;"> </td><td style="width: 33%; height: 40px;"> </td><td style="width: 33%; height: 40px;"> </td></tr> </table> <p style="text-align: center;"><b>Wear</b></p> <p style="font-size: small;">Present = 0, Absent = 1 &gt; 1/3 occlusal dentine &gt; 2mm depth cervical</p>				<table border="1" style="border-collapse: collapse; width: 100%;"> <tr><td style="width: 33%; height: 40px;"> </td><td style="width: 33%; height: 40px;"> </td><td style="width: 33%; height: 40px;"> </td></tr> </table> <p style="text-align: center;"><b>CPITN</b></p> <p style="font-size: small;">Score 2 or less = 1 Score 3 or more = 0 Examine all teeth</p>				<table border="1" style="border-collapse: collapse; width: 100%;"> <tr><td style="width: 33%; height: 40px;"> </td><td style="width: 33%; height: 40px;"> </td><td style="width: 33%; height: 40px;"> </td></tr> </table> <p style="text-align: center;"><b>Subgingival Calculus</b></p> <p style="font-size: small;">Present = 0, Absent = 1 Examine All teeth</p>			
<p>Is the mucosa healthy? <span style="float: right;">Yes   No</span></p> <p><i>Retract tongue with a gauze square</i></p>											
<p>Are 10 or more teeth in one arch opposed by 10 or more teeth in the other arch? <span style="float: right;">Yes   No</span></p> <p><i>With dentures in place</i></p>											
<p>Is your mouth free from pain? <span style="float: right;">Yes   No</span></p>											
<p>Can you chew an unrestricted diet? <span style="float: right;">Yes   No</span></p>											
<p>Are you happy with the appearance of your teeth? <span style="float: right;">Yes   No</span></p>											
<p>Denture examination (where appropriate)</p>											
<p>Is the freeway space &gt; 2 or &lt;7mm? <span style="float: right;">Yes   No</span></p>											
<p>Is the retention and stability acceptable? <span style="float: right;">Yes   No</span></p>											
<p>Is the condition acceptable? <span style="float: right;">Yes   No</span></p>											

  

	Exam Score	Max Score
<b>Wear</b>	<input type="text"/>	<input type="text"/>
<b>CPITN</b>	<input type="text"/>	<input type="text"/>
<b>Subging. calculus</b>	<input type="text"/>	<input type="text"/>
	<input type="text"/>	<input type="text"/>
<b>No. sound/filled teeth</b>	<input type="text"/>	<input type="text"/>
<b>SUB TOTAL</b>	<input type="text"/>	<input type="text"/>
	<input type="text"/>	<input type="text"/>
	<input type="text"/>	<input type="text"/>
<b>TOTAL</b>	<input type="text"/>	<input type="text"/>
<b>OHX INDEX</b>	<input type="text"/>	

Figure 1. OHX Examination Form.