COMMUNITY PERIODONTAL INDEX OF TREATMENT NEEDS

(CPITN)

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SUMMARY

The Community Periodontal Index of Treatment Needs (CPITN) was designed by a joint FDI/WHO working group specifically to assess periodontal status and resultant treatment needs. The group published its recommendations in 1982. The index has been under continuous review as the working group has received feedback on the use of the index from studies carried out in different countries. This index has had limited reported use to date in Australia.

The four major objectives of this treatise were to:

1. Design a series of studies in an attempt to determine the suitability and reliability of this index in measuring periodontal status and treatment needs, to generally assess difficulties in the use of the index, and to gain some Australian data.

2. To test the effectiveness of partial mouth examination of index teeth and combinations of probing sites, and to consider the appropriate selection of teeth to be examined in subjects under 20 years.

3. To determine whether it would be feasible to use the index for routine periodontal screening examination at the Westmead Centre Dental Clinical School.

4. To compare the CPITN index to the previously recommended WHO assessment index, noting that WHO is recommending the international use of this index to replace the WHO (1977) index.
A brief literature review of various periodontal indices was carried out and literature relevant to the CPITN index was reviewed in more detail.

To meet the major objectives, specific objectives were determined for the clinical studies. The main study was carried out on a consecutive sample of 200 subjects 15 years and over at the Assessment & Diagnosis Department, Westmead Centre Dental Clinical School. A study on a sample of 40 subjects under 15 years of age was concurrently carried out. The third study was of 90 first year dental students, at the University of Sydney.

A preliminary study period was spent at the Periodontic Unit, under the supervision of Dr. J. Pritchard, to familiarise the writer with the use of the WHO 621 periodontal probe, probing pressure, probing technique, general examination procedures; and to calibrate the writer in using the CPITN index.

For the clinical examinations, the WHO 1977 index assessment used was that published in Oral Health Surveys: Basic Methods 2nd ed. 1977. The CPITN index method of assessment used was that described by Ainamo et al (1982). A full mouth examination using the CPITN index was carried out on 100 subjects in the 15 years and over age group. For all other subjects, only the index teeth were examined. Each tooth examined had four separate probings recorded for the mesial and distal interproximal areas of the buccal and lingual surfaces. Intra- and inter-examiner duplicate examinations were carried out.
Periodontal status assessed using the CPITN indicated that periodontal disease in the study population was highly prevalent. The majority of periodontal disease was of mild to moderate severity. The majority of treatment required in all age groups could be categorised as "simple periodontal treatment" that could be managed by non-specialist dental resources.

The CPITN index was found to be a simple, appropriate and meaningful index for measurement of periodontal status and treatment needs. However, there are some aspects that could be modified to obtain more accurate and reliable data.

It was evident that reproducible data can be obtained using the CPITN index if examiners are trained to take probing measurements from standardised sites, with standardised direction of insertion and pressure.

Partial mouth examination using four (4) separate probings of the index teeth gave a good assessment of the full mouth appraisal of periodontal conditions of the patients and appears ideal for a screening examination. Two (2) probings of each index teeth gave a "reasonable" assessment of the full mouth periodontal conditions of the patient.

A rational approach in using the CPITN index in children under 20 years would be to exclude the second molars to prevent over-estimation of treatment needs due to the recording of "false pockets".
The index was found to be sufficiently refined and sensitive enough to recommend its use as a routine screening examination at the Westmead Centre Dental Clinical School.

The WHO (1977) index assessments underestimated as well as overestimated the severity of disease when compared to CPITN assessments. The criteria for recording periodontal status and treatment needs using the CPITN index was more objective, scientifically based and appropriate when compared to the WHO (1977) index.
ACKNOWLEDGEMENTS

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1. INTRODUCTION

The Community Periodontal Index of Treatment Needs (CPITN) was designed by a joint working group of the Federation Dentaire Internationale and the World Health Organisation (FDI/WHO) specifically to assess periodontal status and resultant periodontal treatment needs.

Up to the late 1960's periodontal indices for epidemiological assessment of calculus, plaque, debris and the status of the gingival and periodontal tissues, provided the public health planner with only the most peripheral information on treatment needs. There was limited assessment of the need for treatment in populations. Conversion of epidemiological data into estimates of treatment needs are needed by planners and administrators as base-line data for planning, organising and evaluating oral health services.

WHO has expressed a continuing interest in the need for adequate methods of assessing periodontal treatment needs. The CPITN was designed because there were many deficiencies and much dissatisfaction expressed with the existing basic methods of measuring periodontal treatment needs in both individual patients and population groups. The working group published its recommendations for scoring the CPITN index in 1982 (Ainamo et al 1982).

The index since then has been under continuous review as the working group has received feedback on the use of the CPITN from investigators. The group last met in August 1984 to consider any further refinements
to definitions of criteria, application and recommendations for its use following reports of studies carried out in a number of countries. It is expected that the third edition of the World Health Organisation's Manual "Oral Health Surveys: Basic Methods" will, when published, recommend the international use of this index.

The CPITN has had limited reported use to date in Australia. The principal objective for this treatise was to design a series of studies in an attempt to determine the suitability and reliability of this new index to measure periodontal status and treatment needs, to generally assess difficulties in the use of the index and to obtain some data on periodontal status and treatment needs in sample populations of patients at Westmead Centre Dental Clinical School and First Year Dental Students in Sydney, Australia.

The second objective proposed was to assess the effectiveness and reliability of variations in CPITN assessment. The first of these variations was the use of 10 index teeth as a partial mouth examination. Ramfjord's selection of 6 teeth (Ramfjord 1959) was first proposed for partial mouth recording by WHO in 1978. After being tested by various groups in different parts of the world, the working group decided on ten index teeth for partial recording (Ainamo et al 1982). Other variations in methods of assessment proposed for this investigation were to test combinations of probing sites; and the selection of teeth to be examined in persons under 20 years.
The third objective was to determine whether it would be feasible to use the CPITN index in Westmead Centre Dental Clinical School as a practical alternative to the present periodontal screening examination. With the existing screening system, all patients are not being adequately diagnosed and appropriately referred to the hygienists, dental officers and periodontists.

The final objective undertaken for this treatise was to compare the CPITN to the previously recommended WHO periodontal assessment index (WHO 1977), as WHO is recommending its replacement by the CPITN index for international use. Specific objectives for the clinical studies are detailed in Chapter eight and the method and results of the studies are presented in Chapters nine and ten.

Chapters two, three and four give a brief review of the history and development of periodontal disease indices and the measurement of soft and hard deposits. A more detailed review was carried out in areas relating to the CPITN and WHO (1977) indices. These areas, covered in chapters five, six and seven include the measurement of gingival inflammation (with emphasis on bleeding as a diagnostic criteria), periodontal probing, and indices for measurement of periodontal treatment needs.
2. PERIODONTAL INDICES

Periodontal disease is such a common condition that a recording of its mere absence or presence is not sufficient for either the epidemiologist or the clinician. It varies in severity from tooth to tooth within the individual. It is necessary to describe differences in severity rather than prevalence. This variation in severity, together with the lack of precise diagnostic criteria, leads to many difficulties in quantifying periodontal health and disease.

A simple prevalence count does not discriminate between differences in severity. Such differences can be determined by using a specifically designed index.

An index has been defined by Russell (1969) as a numerical value describing the relative status of a population on a graduated scale with definite upper and lower limits, which is designed to permit and facilitate comparison with other populations classified by the same criteria and methods.

In recent years numerous indices have been developed to assess gingival and periodontal disease. While many of these are suited only for epidemiological surveys, others have clinical application (Hurt 1977).
2.1 HISTORY OF DEVELOPMENT OF PERIODONTAL INDICES

Dental epidemiology with all its index systems is a fairly young science (Ainamo & Bay 1975).

One of the first attempts at categorising periodontal disease was by Black in 1918. He used only a questionnaire and radiographic evidence to investigate what percentage of the population at various age levels had evidence of 'periodontal infection'. He found that this 'periodontal infection' was rare under 20 years of age and ranged from 13 percent in the 20-24 age group to 88 percent in those above 50 years.

Other investigators prior to 1944 were mainly interested in the percentages of the people affected by the disease. The methods used were generally arbitrary and subjective; the criteria commonly used were 'mild, moderate and severe' or 'poor, medium and good'. Such recordings did not enable valid comparison between different groups of subjects or even between subjects within a group since there were no clear criteria outlining the various degrees of severity in the studies.

The periodontal index systems developed later were devised for specific purposes. The first attempt towards objective quantification of the severity of gingivitis was the PMA index, (papillary, marginal, and attached gingiva) published in 1947 by Schour and Massler. The PMA index has been modified by Parfitt (1957) and used extensively in periodontal epidemiology, especially of children.
A major criticism of early indices was that they did not provide for the 'destructive' phases of periodontal disease (Waerhaug 1966). In an attempt to provide the profession with an index which considered both the gingival status and the destructive phases of periodontal disease, Russell developed the Periodontal Index (Russell 1956). This index was designed solely to be an epidemiological tool and not meant to be used clinically (Russell 1967).

Sandler and Stahl (1959) outlined an index called the Periodontal Disease Rate (PDR). Each tooth was assessed using radiographs and clinical indicators such as mobility, pocket depths, and appearance of gingiva to classify as 'affected' (a) or 'not affected' (b). The PDR was then calculated using the formula \[ \frac{a}{a+b}\], where \( a + b \) is the total number of teeth present in an individual, (a) the number of teeth affected by disease, and (b) the number of teeth not affected by disease.

Ramfjord (1959) developed a screening system which he called the Periodontal Disease Index (PDI). It was designed to meet the needs of both epidemiologist and clinician. It contains criteria for assessing gingival status and measuring loss of attachment.

The association between periodontal disease and oral cleanliness became clear by the end of the fifties and the need to categorise oral hygiene status was expressed (Greene & Vermillion 1960). Greene and Vermillion (1960) produced a precise and sensitive Oral Hygiene Index (OHI) which became the simplified Oral Hygiene Index in 1964 (Greene &
Vermillion 1964). 'An epochal contribution to the scoring of plaque and gingivitis was made by Løe & Silness in the early 1960's' (Ainamo & Bay 1975). Løe and Silness introduced the Gingival Index and the Plaque Index (Løe & Silness 1963, Silness & Løe 1964). 'These 2 indices made it possible to demonstrate the indisputable correlation between plaque formation and initiation of gingivitis' (Ainamo & Bay 1975).

The Retention Index System was introduced in 1967 by Björby and Løe (Løe 1967). It assessed the main retentive factors which encouraged bacterial accumulation in the gingival area such as calculus, overhangs, and caries.

Mühlemann and Mazor (1958) believed that bleeding from the sulcus was the earliest clinical sign of gingivitis, and introduced an index in 1958, originally called 'PM' (papilla, marginal gingiva) but later renamed the Sulcus Bleeding Index (Mühlemann & Son 1971). They maintained that the Sulcus Bleeding Index was more positive than Løe's Gingival Index system and considered it to be a simple, reproducible and a rapid screening method, even with untrained examiners.

Ainamo and Bay felt that screening of plaque and gingivitis should be made easy to enable patients to monitor their own progress in preventive or curative periodontics. They proposed an index based on the findings of bleeding on probing or tooth brushing. This index was found to have a high correlation to the Löe and Silness Gingival Index that was statistically significant (Ainamo & Bay 1975).
Several investigators were concerned that despite the various indices, a quick, effective appraisal of treatment needs was still difficult. It was suggested that epidemiological surveys had not addressed the need for treatment and had not proven to be an adequate basis for determining clinical needs (Ramfjord 1969).

Bellini (1974) found no reliable association between numerical epidemiological parameters and treatment requirements or time evaluation. He felt that any planning for periodontal treatment and delivery systems must provide a realistic picture of the need for prevention and therapy, and include estimation of manpower and resources involved. Bellini felt that there should be an assessment that would clearly evaluate the treatment required, relating it to time and giving a basis for calculation of manpower and cost. One system proposed was the Periodontal Treatment Needs System (Johanson et al 1973). The system was based on evaluation of the need for certain standardised treatments and the time required to perform them.

By the end of the 1960's there was no doubt that bacterial plaque was the etiological agent responsible for periodontal disease (Ainamo 1981). From the seventies, efforts were made to create indices for the assessment of treatment needs in a given population. Indices for periodontal treatment needs have been developed to enable the dental practitioner to classify patients into treatment categories according to their periodontal condition (Johansen et al 1973, Ainamo et al 1982) and hence expedite their treatment.

Based on the recommendation of expert committees, the World Health Organisation (WHO) has, over the years published several methodologies for assessment of periodontal status for public health purposes.

In 1961 a WHO Expert Committee recommended the use of Russell's Periodontal Index as the basic method of assessment in epidemiological studies, and that where additional information was required other indices could be used (WHO 1961).

In 1962 another committee found that inter-examiner reproducibility using the above method was low and recommended a simplified method (WHO 1962).

In 1965-66 a WHO group concluded that while the 1962 method was suitable for public health prevalence surveys, more detailed methods were needed for descriptive epidemiological studies as well as clinical trials. Russell's Periodontal Index was again recommended for descriptive epidemiological studies. In addition, it was suggested that oral hygiene status be assessed as its relationship to periodontal disease was well established. Greene and Vermillion's Oral Hygiene Index - Simplified was recommended as the index of choice. For clinical trials the group recommended the use of Ramfjord's Periodontal Disease Index (PDI) (Davies 1968).

In 1971, WHO published a manual entitled Oral Health Surveys: Basic Methods (WHO 1971). It was hoped that standardisation of dental
survey methods would facilitate the collection of global oral epidemiological data. The chief purpose of the 'basic survey' was to provide reliable epidemiological data to assist in developing and conducting a regional or national dental health programme. This first edition of WHO's Oral Health Surveys contained a method for a gross assessment of periodontal disease. The 1971 survey method was used in more than 30 surveys (Davies & Barmes 1976) but experience revealed some deficiencies. It was noted that the method in the first edition did not contain any assessment for the treatment needs other than for the number of teeth extracted because of periodontal disease (Horowitz 1979).

A compromise criteria was proposed in the revised WHO 'Oral Health Survey: Basic Methods' published in 1977 (WHO 1977). The methods for assessing periodontal disease and treatment needs in this second edition were an improvement. However, there was still much dissatisfaction with the method and it was still not possible to compute time requirements for care which should be an integral component of an index for treatment needs (Horowitz 1979).

Late in 1977, a WHO Scientific Group considered 'Epidemiology, Etiology and Prevention of Periodontal Disease' at a meeting in Moscow. After a detailed critical review of the current survey methods a recommendation to use a different basic approach to the assessment of disease status and treatment needs was published (WHO 1978).
Following the WHO (1978) recommendations a joint FDI/WHO working group was formed. Their final recommendation for scoring the Community Periodontal Index of Treatment Needs (CPITN) was published in 1982 by six members of the joint FDI/WHO Working Group (Ainamo et al 1982).
2.2 OBJECTIVES OF PERIODONTAL DISEASE INDEXATION

The objectives for a scoring system, or an index, for periodontal disease were summarised by Ramfjord (1959).

1. To map distribution of the disease (prevalence)
   (a) In population groups
   (b) Within each dentition
   (c) Around each individual tooth

2. To record the progress and behaviour of the disease either by longitudinal studies of the same group or by comparing prevalence studies of various age groups within the same population (incidence).

3. To serve as a basis for evaluation of the role of various etiologic factors in the pathogenesis of periodontal disease.

4. To estimate the total need for periodontal therapy in population groups.

5. To educate the dental profession, the public and government authorities regarding the need for periodontal care and treatment.

6. To estimate future needs for dentists and auxiliary personnel.

7. To evaluate the clinical effectiveness of various procedures or agents in the prevention and treatment of periodontal disease.

8. To enable dentists to classify patients into disease categories and relate them to treatment.
2.3 REQUIREMENTS OF A PERIODONTAL DISEASE INDEX

In evaluating a periodontal index, Hazen outlined the following requirements (Hazen 1974):

1. An index must be simple to use and permit the study of a large number of persons with a minimum of time and cost.

2. Criteria defining the component of the index should be clear and understandable to promote accuracy and reproducibility.

3. A severity index should be equally sensitive throughout and should indicate in a meaningful way the clinical stages of the disease process.

4. The index should be amenable to statistical analysis.

Horowitz (1979) stated that any good index, besides possessing all of the attributes listed by Hazen should provide a measurement of the time needed for and the complexity of treatment to serve as a basis for calculating manpower requirements and cost estimates for the delivery of care.

Barmes (1976) stated the ingredients a public health planner wants from any disease assessment are:

1. Overall disease status - as a yardstick for preventive and curative service achievements and as a direction finder.

2. Treatment needs - as the main basis for manpower calculations.

3. Treatment met - to indicate how much of the need is being serviced.

4. Treatment failed - as a quality assessment.
3. INDICES FOR MEASUREMENT OF SOFT DEPOSITS

3.1 REVIEW OF INDICES

Mandel (1974) considered that assessment of non-mineralised tooth deposits (plaque, materia alba, debris, pellicle and stain) is important in:

(a) epidemiological studies relating local factors to periodontal disease.

(b) evaluation of oral hygiene status of individual patients.

(c) clinical studies measuring cleansing efficiency of oral hygiene procedures and anti-plaque agents.

Indices for measurement of plaque area:

The most common criteria for plaque scoring is the extent of the area occupied. In most instances, the area is assigned a number and a numerical index is derived from a mean score per tooth or tooth surface. Teeth examined vary from total mouth, to six selected teeth, to anterior teeth only.

Area measurements - numerical indices used are:

The plaque measuring component of the Periodontal Disease Index (PDI, Ramfjord 1959).

Ramfjord's PDI, modified by Shick and Ash (Shick & Ash 1961).

Quigley and Hein Index, modified by Turesky (Quigley & Hein 1962) (Turesky et al 1970).

The plaque measuring component of the Gingival Periodontal Index (GPI, O'Leary 1967).

Navy Plaque Index modified by Hancock and Wirthlin (Hancock & Wirthlin 1977).
Plaque area measurements - Quantitation of total area:

Arnim (1963) compared the efficiency of various hygienic procedures by determining the total amount of plaque present on the labial surfaces of the four upper and lower incisor teeth. Photographs of the tooth surfaces were taken after staining and the kodachrome transparencies enlarged four times. Outlines of respective tooth surfaces and stained masses were traced on paper and their areas determined with a planimeter. The percentage of surface covered by the plaque was calculated.

Kinnoshita et al (1966) modified the Arnim procedure. The colour slides were projected at 65 times magnification and the areas of plaque and unstained tooth surface traced on paper and cut out for gravimetric determination. The percentage of tooth surface covered by the plaque was then calculated.

Disadvantages of intra-oral photographic methods in scoring plaque have been summarised by Grenby et al (1982).

1. It is difficult to ensure all teeth are in focus, properly illuminated and seen from exactly the same angle every time.

2. It can only measure the area of the plaque and not the bulk. This criticism applies to all plaque area measurements.

3. The uncertainty of distinguishing areas of plaque from pellicle which is also stained by disclosing solution such as erythrosin.
Stean and Forward (1980) similarly criticised photographic methods. They claimed percentage area measurements can measure plaque on a continuous scale and are sensitive enough to detect small treatment effects. They stained the plaque with erythrosin and used an experienced examiner to draw the outline of stained plaque onto tooth chart diagrams. Areas of plaque were measured using an electronic measuring planimeter.

Bergstrom (1981) used the labial surface of upper lateral incisors and a stereo-photogrammetric method to assess the accumulation of plaque in-vivo. The area covered by plaque is given as a percentage of the total surface area of the tooth. He concludes that this is a sensitive method for measurements of small amounts of plaque in clinical studies.

Area measurements provide more quantitative data than numerical indices. However, they are more time consuming and lend themselves most readily to incisor teeth (Mandel 1974).

Index for measurement of plaque thickness:

An index in which plaque thickness is an important consideration, was introduced by Silness and Løe in 1964 and described more fully in 1967 (Silness & Løe 1964, Løe 1967).
Plaque weight determination:

Marthaler, Schroeder and Mühlemann (1961) used sandblasted, standardised mylar foils attached to the lingual surfaces of lower anterior teeth as a means of measuring total plaque weight. After exposure to various clinical conditions, foils were dried at 110°C and weighed, the deposits were removed chemically, the foils redried and reweighed. This is a time consuming procedure best suited to pilot studies but with limited applicability to general clinical testing.

Loesche and Green (1972) examined plaque using both wet (weighing within one minute) and dry weight (at 95°C constant weight). They found wet weight to be the preferred measurement for estimating plaque mass.

Caldwell et al (1970) scraped the plaque from 6 tooth surfaces as suggested by Greene and Vermillion after a one week period. The plaque material was dried over night at 85°C and weighed.

Other parameters:

The plaque dry weight is composed of carbohydrate, nitrogen and inorganic materials. In several studies, (Loesche & Green 1972, Caldwell et al 1970, Lobene 1970) chemical assays were performed to measure carbohydrate and nitrogen content of plaque. Loesche and Green (1972) found that carbohydrate and nitrogen contents correlated poorly with gingivitis scores or plaque dry weight. Chemical assays seem to be more appropriate for determining plaque pathogenic potential rather than the general amounts of plaque.

Indices for measurement of oral debris:

Several investigators, in assessing oral hygiene status, used oral debris scores rather than plaque measurements. The widely used Greene and Vermillion Simplified Oral Hygiene Index (OHI-S) (1964) includes separate measurements for oral debris and calculus. The Simplified Oral Hygiene Index is derived from the original Oral Hygiene Index to allow a more rapid evaluation of oral cleanliness in population groups.

Glass (1965) used a modified debris scoring system which had greater clinical applicability than the OHI-S.

Podshadley and Haley (1968) introduced a modification of the debris index of Greene and Vermillion, which has applications to clinical testing. This scoring technique allows for quantitation of differences within the gingival third area and may be a better tool for clinical studies than the Greene-Vermillion index.
3.2 CRITERIA FOR SELECTING AN INDEX FOR MEASURING SOFT DEPOSITS

3.2.1 Epidemiological Studies

Epidemiological studies are primarily used for the purpose of disclosing differences in prevalence and severity and for associating the presence or absence of the disease with specific agents and factors.

Greene (1959) listed the characteristics of an index suitable for plaque or oral debris measurements in epidemiologic studies.

1. The method of choice must have definite scoring criteria which reduce examiner decisions to a minimum.

2. The techniques to be employed must be simple to apply and within the abilities of those using them. Periodontal specialists or original researchers of the index in use are rarely available for extensive field work.

3. Speed of application is preferred to sensitivity in measuring small differences. The scales of the scoring system need not be as refined as those designed for experimental clinical trials.

4. The method however, must be sufficiently quantitative to provide a measure of the degree of severity so that the final score can be analysed statistically.

5. Epidemiologic studies usually involve examinations from several investigators and their results compared. Inter- and intra-examiner errors are of primary concern and must be reduced to a minimum.

Ramfjord's PDI and Greene and Vermillion's OHI-S have a plaque or oral debris scoring component which fulfills the criteria listed by Greene. Both indices were used extensively by investigators on a world-wide basis.

Greene and Vermillion OHI-S does not require the use of a disclosing agent or rinsing and is the most appropriate measure for oral hygiene status for epidemiological studies. The WHO (1979) publication recommended the OHI-S for measurement in large populations.
3.2.2 Clinical Studies

According to Mandel (1974), the selection of a particular index for measuring soft accumulations on the teeth in clinical studies, should relate to:

1. the nature of the agent
2. the procedure to be tested
3. the objective of the study

In general, he says the most likely possibilities would be:

1. measurement of cleansing efficiency per se, such as in mechanical removal of soft deposits
2. relation of the deposits to gingival health
3. measurement of plaque formation under certain specified conditions or procedures

The number and age of patients to be examined, frequency of examination and conditions under which examinations are to be conducted must enter into selection.

Numerical indices:

The Ramfjord index (modified by Shick & Ash) is recommended for clinical studies designed to evaluate effectiveness of agents or procedures that alter the development of plaque and its relationship to gingival disease (Mandel 1974).

The Quigley Hein Index modified by Turesky et al (1970) emphasises differences in plaque accumulation on the gingival one-third of the tooth. The weighting of scores to differentiate relative subtle amounts of plaque along the gingiva enables it to reflect the realities of the plaque - gingival inflammatory relationship rather than just aesthetic considerations (Mandel 1974). Where cleansing efficiency rather than plaque-gingival relationships are under investigation, any index assessing the total tooth surface could be used (Mandel 1974).
Total area measurement:
Total area measurements of plaque are subject to substantial error whether the disclosed plaque is recorded by camera or drawn on standardised tooth charts by experienced examiners. In view of the paucity of data on accuracy and reproductibility, and the considerable time and effort involved, total area measurements would appear to have limited application to clinical studies involving any appreciable number of subjects (Mandel 1974).

Plaque thickness:
In experienced hands, the Plaque Index of Silness-Löe (1964) is very useful for evaluating oral cleanliness.

The Silness-Löe Index, if examiners are standardised, should be a useful technique for evaluating anti-plaque agents and procedures. A measurement of thickness rather than area is more meaningful in the pathogenesis of gingival disease (Mandel 1974).

Plaque weight:
The chief advantage of plaque weight measurement is that it is more objective. Plaque weight measurements have the advantage over the visual area measurements in that plaque thickness is fully accounted for. However, there is uncertainty in the technique of complete removal of the plaque.

One of the major disadvantages of the plaque weight procedure is that daily measurements in individual subjects are not possible. Once plaque is scraped off, at least 3 days must elapse before sufficient material accumulates for further weighing. A reasonable combination
would be visual examination during the experimental period followed by plaque removal for weighing at the end of the period (Mandel 1974).

Other parameters:
Chemical examination would appear an appropriate means of determining a specific effect of an agent or procedure rather than a general indicator of the amount of plaque (Mandel 1974).

Pathogenic potential measurements:
Gottsegen (1974) suggested that the pathogenic potential of plaque is as important as the volume and rate of its formation in periodontal disease.

Mackler and Crawford (1973) in a three week study of no oral hygiene routine in children found there was development of plaque and complex flora with no subsequent gingivitis.

Fine et al (1978) reported that loosely adherent plaque collected from periodontal pockets had a higher mitogenic and pyrogenic activity than adherent plaque collected supra-gingivally. This is in spite of the fact that the mass for adherent plaque was four to five times greater than loosely adherent plaque. Methods for measuring pathogenic potential of plaque in terms of plaque pH, specific organisms, enzymes or toxins would represent a whole new area for clinical testing.
4. INDICES FOR MEASUREMENTS OF HARD DEPOSITS

4.1 REVIEW OF INDICES

4.1.1 Epidemiological Indices

Epidemiological indices are used to study the evidence of periodontal disease and the oral health status of different populations. Two indices, which include calculus quantitating components, are Ramfjord's Periodontal Disease Index (1959) and Greene and Vermillion's Oral Hygiene Index (1960).

Although these indices have been used almost exclusively in epidemiological surveys, some clinical studies of calculus have been conducted using the calculus quantitating components of these indices.

4.1.2 Indices for Clinical Calculus Studies

The early clinical studies from the mid 1940's to the late 1950's were conducted to evaluate the effect of calculus inhibiting materials. The results were usually clinical impressions obtained from a direct visual examination (Kerr & Field 1944, Grossmann 1954) or through the use of intra-oral photographs (Jensen 1959).

These techniques were basically subjective, but rapid, estimations of the presence or absence of calculus and/or the amount of calculus that had accumulated. Little effort was directed towards the establishment of examiner standardisation and reproducibility procedures.
During the decade from 1960 to 1970, a considerable clinical research effort was expended in developing calculus quantitating procedures that were objective and reproducible. Three major quantitating methods for the direct in-vivo measurement of calculus deposits were introduced. The three methods were:

1. Calculus Surface Index (and its companion Calculus Surface Severity Index) (Ennever et al 1961)

2. The Probe Method of Calculus Assessment (Volpe & Manhold 1962)

3. Marginal Line Calculus Index (Mülhemann & Villa 1967)

A method was also developed which permitted the indirect evaluation of calculus deposits. This method was the Standardised Foil Technique of Marthaler et al (1961).

All four procedures were developed for the clinical evaluation of calculus inhibitory materials or formulations.
4.2 CRITERIA FOR SELECTING AN INDEX FOR MEASURING HARD DEPOSITS

4.2.1 Epidemiological Surveys

Both the PDI and the OHI-S calculus components have been used extensively in epidemiological surveys and there is considerable data available concerning examiner reproducibility of the indices.

Both the PDI and OHI-S scoring place emphasis on subgingival calculus and have good reproducibility in the hands of trained examiners. The OHI-S calculus scoring scale has defined its criteria in more precise terms than those of the PDI, and is the index of choice for epidemiological studies.

4.2.2 Clinical Studies

The specific recommendations for a particular calculus quantitating index will depend on the purpose and design of the clinical study, the size of the population sample to be examined, the period of study, and the type and extent of changes anticipated.

The clinical evaluation studies can be arbitrarily classified as short term screening procedures (pilot studies) and long term clinical studies.

The purpose and design of the clinical study would determine whether the investigator needs to assess the following characteristics of the calculus deposits that he will probably encounter.

1. Location - predominantly anterior teeth, posterior teeth or both; proximity of calculus to gingival tissues.
2. Type - predominantly supragingival, subgingival or both.
3. Quantity - 'flakes', 'specks' or large solid areas.
When these characteristics are established, the investigator can select that index which will most accurately quantitate the particular calculus deposits that he anticipates encountering in his particular clinical calculus study.

The index must also possess the following important properties:

1. It has demonstrated examiner reproducibility.

2. It has been previously used in clinical investigations, thus providing a source of reference data for future clinical investigations.

3. It can detect small amounts of calculus. This is of great importance in short term studies.

4. The clinical scores should correlate with dry weight of calculus.

Short term screening procedures:

The short term screening procedures for experimental clinical studies are usually conducted from one to five or six weeks. A small number of subjects may be used to evaluate the effectiveness of several materials in-vivo in respect to their ability to inhibit the formation of supragingival and subgingival calculus.

The direct (clinical) calculus quantitating methods recommended by Volpe (1974) for short term screening procedures, were the Calculus Surface Index of Ennever et al (1961) and the Marginal Line Calculus Index of Mühlemann and Villa (1967).

The indirect (or clinical-laboratory) calculus quantitating method that is recommended for studies of this type, is the Standardised Foil Technique of Marthaler et al (1961).
Long term clinical trials:
In studies of this nature, selected materials are carefully evaluated for a duration corresponding to the actual in-vivo calculus accumulation pattern. This can take one year or longer. Usually a selected inhibitory material is compared to its proper control formulation in a series of carefully conducted and supervised investigations to establish and document the efficacy of the material.

Volpe (1974) recommends the Probe Method of Calculus Assessment developed by Volpe and Manhold (1962) for these studies. The calculus quantifying components of the PDI of Ramfjord (1967) and the OHI-S of Greene and Vermillion (1964) are also recommended for use in long term studies, especially when investigators are already very experienced in their application.
5. INDICES FOR MEASUREMENT OF GINGIVAL INFLAMMATION

5.1 REVIEW OF INDICES

A review of the literature indicates that there are almost as many indices for the measurement of gingival inflammation as there are investigators who have reported on the subject (Hazen 1974). A few of these indices have been categorised together in this brief review.

Descriptive indices:

Descriptive indices of gingival inflammation appear early in the literature and have been used in studies as late as the 1960's (Aimsworth & Young 1925, Marshall-Day & Tandan 1944, Pindborg 1951, James et al 1960, Zachrisson 1968).

The results of these studies were usually presented as the percentage of subjects having normal gingiva, slight gingivitis, moderate gingivitis and severe gingivitis. The studies do not lend themselves readily to statistical analysis and with differing, or not stated criteria, lack comparison to present day indices.

Present or absent indices:

Several investigators have used variations of 'present or absent' indices which do not consider the severity of gingival inflammation. (Arno et al 1956, King et al 1944, Hoover & Lefkowitz 1965, Baume 1968).

Such an index would be simple, reproducible with little examiner training, require relatively little time to conduct the oral
examination and would lend itself to statistical analysis. Problems arising from assigning relative weights to different gingival inflammation parameters of severity scales would also be avoided. These indices are useful in studies where prevalence data are the primary requirement (Baume 1968). Recent researchers have refined the 'present or absent' type of indices by selecting a single entity which is both sensitive and specific for gingivitis. Gingival bleeding has been favoured by many researchers as such a criteria and examples are: The Gingival Bleeding Index (Carter & Barnes 1974); and The Gingival Bleeding Index (Ainamo & Bay 1975).

Numerical indices:

There are many numerical indices for scoring severity of gingival inflammation. Most of these are weighted, emphasizing for example, colour change (Suomi & Barbano 1968), bleeding (Mühlemann & Son 1971), the facial rather than the lingual, or the most severely affected area in a segment (O'Leary 1967). Values for similar criteria, such as changes in form or colour are given different weights in different indices.

The best known numerical indices are:

The PMA Index as modified by Parfitt (1957)
Periodontal Index (PI, Russell 1956)
Periodontal Disease Index (PDI, Ramfjord 1959)
Gingival Index (GI, Silness & Löe 1964)
The Suomi and Barbano Index (1968)
Dental Health Centre Index (DHCI, Smith et al 1970)
Gingival - Periodontal Index (GPI, O'Leary 1963)
Navy Periodontal Disease Index (NPDI, Hancock & Wirthlin 1977)
Sulcular Bleeding Index (SBI, Mühlemann & Mazer 1958, Mühlemann & Son 1971)
Papilla Bleeding Index (Mühlemann 1978)
Periodontal Pocket Bleeding Index (van der Velden 1979)
The Gingival Bleeding Time Index (Nowicki et al 1981)

Among the authors of the various indices there is disagreement as to the order of occurrence of the various parameters of inflammation in the progression of gingivitis.

Photographic methods:
Photographic methods of assessing gingival health have been used. Massler et al (1957) stated that good colour photographs were as important to the evaluation of gingival changes as good radiographs were for the evaluation of hard tissue changes.

Suomi et al (1972) reported that visible changes in gingival colour could not be determined from colour slides and reproducibility was not any better than that for a clinical evaluation. Lees (1974) reported that photographs were unreliable for assessing the gingival state in the molar region.

Despite limitations of photographic methods, a series of good quality and reasonably standardised colour transparencies has advantages in the assessment of examiner variability and may be useful in standardisation of examiners. (Davies et al 1967, Llewelyn & Addy 1979).
5.2 BLEEDING AS A DIAGNOSTIC CRITERIA

The need for objective signs in the assessment of periodontal changes has been frequently emphasised (Ramfjord 1959, Davies et al 1967, Alexander 1970a, Hazen 1974).

Many of the indices utilized today to assess the severity of gingival inflammation depend on the subjective clinical evaluation of changes in colour, contour and consistency of the tissues. The inflammatory response of the gingival tissues and its interpretation is very complex. Ainamo and Bay (1975) stated "the sensitive gradings of different degree of redness, swelling and bleeding of the gingiva may be easily recognised by the experienced researcher but they are certainly not unambiguous to the majority of the dental profession".

It is extremely difficult to determine initial gingival disease activity through plaque indices, changes in gingival colour and contour and evidence of periodontal pocketing. Indices using these criteria lack the sensitivity that clinicians require to detect early changes. On the other hand, bleeding from the gingival sulcus always can be seen before there is clinically apparent inflammation (Carter & Barnes 1974). The same authors also felt that measurement of a clinical sign is a more meaningful indicator of disease activity than the measure of clinical appearance of the tissue.

Mühlemann (1971) stated "bleeding from the sulcus upon probing is a clear-cut sign of pathology, easily diagnosed by the non-expert. Colour changes are less obvious during early stages of gingival disease and
are most often overlooked". Mühlemann (1971) also demonstrated that bleeding from the gingival sulcus was the earliest clinical sign of gingivitis. Further support for bleeding as an early clinical sign has been provided by Lennox and Kopezyk (1973) who noted that bleeding points do not correlate directly with clinical inflammation but rather precede apparent inflammation.

A study was undertaken by Meitner et al (1979) to classify whether visual inflammation or gingival bleeding on probing was the earlier indication of gingivitis. They reported that when healthy gingival surfaces (no oedema, erythema or gingival bleeding upon stimulation) developed clinically detectable signs of inflammation, a significantly greater number of areas manifested gingival bleeding upon stimulation alone as compared to either visual signs of inflammation alone (erythema and/or oedema) or a combination of both visual signs of inflammation and gingival bleeding.

Since the prevention of periodontal disease is actually the treatment of initial gingivitis, the very earliest signs of inflammatory gingival disease needs to be recognized (Mühlemann & Son 1971). The use of bleeding instead of visual inflammation as an indicator of early gingival pathology has the clinical advantage that it is a more objective (less subjective) clinical sign. Bleeding is either present or absent, whereas colour changes and degree of inflammation requires more subjective estimations by the examiner (Meitner et al 1979). Bleeding as a diagnostic criteria needs only one decision of the practitioner to obtain a score (Garnick 1980).
Objective clinical criteria are needed which reliably reflect histopathologic changes associated with gingivitis and periodontitis. Studies attempting to define associations between clinical and histologic characteristics of periodontal disease have been reported. Weak correlations were found by some investigators (Ambrose & Detamore 1960, Zachrisson & Schultz-Haudt 1968, Daneshmand & Wade 1976, Shapiro et al 1979) and strong correlations by others (Rudin et al 1970, Oliver et al 1969, Hancock et al 1979).

Greenstein and co-workers (1981) designed a study to histologically characterise the gingival lesion associated with visual signs of inflammation and bleeding after probing, using a standardised force. Their studies revealed that clinical sites which bled after probing with standardised insertion and pressure of 25 G had a significantly greater area of inflamed connective tissue compared with probed specimens which had absence of bleeding. They concluded that the histological findings related to gingival bleeding after probing have considerable clinical significance and the use of bleeding as an indicator of early gingival pathology has the advantage that it is a more objective clinical sign.

Slots et al (1979) demonstrated a high degree of correlation ($r = +0.90$) when gingival bleeding and crevicular fluid flow were compared and they in turn correlated positively with the total subgingival bacterial counts and the proportion of subgingival spirochetes.
Hancock et al (1979) evaluated the relationship between clinical status, gingival crevicular fluid flow and histologic status of the gingiva. The inflammatory status of the area was assessed using criteria based on bleeding tendency and tissue consistency. They reported strong correlations between clinical and histologic scores.

Investigations by Engelberger and co-workers (1983) demonstrated that as bleeding increased in severity, there was a clearly evident increase in the size of the infiltrated connective tissue segment as well as a positive correlation with the density of the inflammatory infiltrate. Their comparisons of the Papilla Bleeding Index (PBI) with the histological determination of inflammation revealed:

1. a clear increase in the absolute amount of inflammatory infiltrate as PBI scores increased

2. a definite shift in the intensity of the infiltration, moderate and severe areas of infiltration became more common as PBI scores increased.

A study by Nowicki et al (1981) has shown that high correlations exist between the time required for bleeding to appear after probing, the Gingival Index and gingival exudate measurements.

A number of authors (Mühlemann & Son 1971, Carter & Barnes 1974, Ainamo & Bay 1975, Engelberger et al 1983) have pointed out the usefulness of the phenomenon 'bleeding' for individual patient motivation. The bleeding symptom - being readily reversible - would also function as a motivating factor in activation of the patient to better oral home care (Ainamo & Bay 1975). Carter and Barnes (1974), and Ainamo and Bay (1975) (when introducing their Gingival Bleeding
Index in 1975) said that the instructed patient is able to use floss to detect bleeding and this provides a self evaluative instrument in the home and serves as a motivating factor for achievable goals.

The Papilla Bleeding Index has proven extremely useful for the practising dentist because it permits both an immediate evaluation of a patient's gingival condition, as well as his motivation, based upon the actual bleeding tendency of the gingival papilla. In the private dental practice, where diagnosis, motivation and evaluation of the success or failure of prophylaxis and therapy are daily tasks, the PBI has achieved great importance, particularly in Switzerland (Engelberger et al 1983).

Bleeding on probing is also used for the detection of an inflammatory lesion which may persist at the base of a pocket in the absence of visual inflammation at the gingival margin (Garnick 1980). Persistence of bleeding on probing from pockets in the absence of marginal inflammation is one of the criteria of progressive chronic periodontitis (Seymour et al 1979). The greater penetrability of the tip of the periodontal probe into inflammed periodontal tissues results in bleeding from the connective tissue at the base of the pocket, which is a much more critical diagnostic feature than the actual depth of the crevice. (Holborow et al 1983). Greenstein et al (1981) said that the critical area of importance for assessment of inflammatory lesion in periodontitis is at the base of the periodontal pocket, an area inaccessible for visual evaluation. This, Greenstein et al believe is the greatest potential for bleeding as an objective diagnostic method.
It is becoming increasingly evident that bleeding on probing is considered to be the most valuable diagnostic criteria in evaluating gingival health or disease. A World Health Organisation report (WHO 1978) described the absence of bleeding as a characteristic sign of a healthy gingiva.

**Reliability of bleeding as a diagnostic criteria:**

There is, however a strong subjective component to a clinical examination for gingival bleeding. The force of probing and the state of the gingival tissues are the two major variables that affect the outcome of the examination.

The tip of a periodontal probe is inserted into, and moved along the gingival sulcus by the examiner. Although the term "gentle" is always used in describing the technique, it has been shown that there is great variation in periodontal probing pressure even among experienced clinicians (Gabathuler & Hassell 1971, Hassell et al 1973).

Gabathuler and Hassell (1971) recorded forces averaging 75 ponds/mm during sulcus probing to determine Sulcular Bleeding Index scores. Hassell et al (1973) reported forces during sulcus probing of from 23.3 to 109.2 ponds (one pond = one gram absolute force). Robinson and Vitek (1979) regarded 25 grams as the most common load applied. Freed et al (1983) investigated the range of probing forces used by 58 dental practitioners with a pressure sensitive probe and found it to be between 5.0 to 135.0 grams. They also recorded a relatively broad
intra-examiner range (mean = 43.9 grams) and noted that inconsistent forces were used by most clinicians.

Using a pressure-sensitive probe, van der Velden and his co-workers (van der Velden & de Vries 1978, van der Velden 1979, 1980, van der Velden & Jansen 1981) have repeatedly shown that an increase in probing force results in an increase in probe penetration and bleeding tendency. The results of van der Velden were corroborated by Proye, Caton and Polson (1982) who recorded probing depth and bleeding tendency using 15 G, 25 G, 50 G and manual (uncontrolled) probing forces. Results showed a consistent increase in bleeding tendency and probing depth as probing force increased. They also noted that probing depths and percentages of bleeding pockets were always greater when using manual uncontrolled force than those found at even 50 G of probing force. In comparing 15 G with 50 G of probing force, the difference in percentage of bleeding pockets was as much as 32 percent. The accuracy of bleeding indices must be questioned if force is not controlled (van der Velden 1980, Proye et al 1982, Caton et al 1982).

These studies that have been cited infer that the use of excessive force during probing may elicit a false positive bleeding tendency in healthy tissues. The critical importance of insertion pressures is further verified by the fact that even with a controlled force the depth of sulcus penetration may vary depending upon the inflammatory state of the adjacent gingival tissues (Armitage et al 1977) There is speculation that inaccuracies may be even more pronounced in inflamed tissues (van der Velden & Jansen 1981, Garnick et al 1980, Hancock &

All these factors emphasise the need for controlled insertion pressure, with clear delineation of probing technique, in order to make bleeding evaluations reproducible and objective. If this can be obtained, detection of bleeding may be a sensitive and reliable method for diagnosis of initial stages of gingivitis. This would help resolve some of the dilemmas as to which clinical signs should be used as indicators for the need of treatment (Sheiham 1977).
5.3 **CRITERIA FOR SELECTING A GINGIVAL INDEX**

"It is unlikely that any gingivitis index is sensitive to all types of gingivitis, has specific meaning for all stages of the disease process, is equally applicable for the needs of all types of clinical trials, provides comparable interstudy data and is equally useful for severity assessments in all population types" (FDI 1976).

The use of a particular index will depend on the purpose and design of the study and on the characteristics of index that reflect most accurately and reliably the features which the investigator wishes to evaluate.

Gjermo (1974) listed four different types of studies which require different gingival index systems:

1. Epidemiologic surveys on prevalence and severity.
2. Longitudinal experimental studies to evaluate prophylactic and/or therapeutic measures in population groups.
3. Clinical trials in small, well controlled, experimental groups.
4. Periodontal treatment needs evaluation.

**Gingival indices for epidemiologic surveys of prevalence and severity:**

Epidemiological surveys on the prevalence and severity of gingivitis in large populations require an index which is fairly quick to apply and which needs little equipment and technical facilities.

In surveys of this type, there is usually no need for refined assessments of localisation by tooth or area of the mouth, or of the severity of the gingivitis. As it is generally accepted that
gingivitis precedes destructive periodontitis, indices which consider both gingival inflammation and periodontal breakdown are preferable.

Russell's Periodontal Index (PI, 1960) and to a certain degree the Periodontal Disease Index (PDI, 1959) proposed by Ramfjord fulfill these requirements. A modification of the Gingival Index (GI) of Løe and Silness using only the originally proposed index teeth may be a useful tool since experience has shown to be a highly reproducible index for gingivitis (Hazen 1974). Some of these considerations are also valid for the Suomi-Barbano index (Hazen 1974).

Gingival indices for longitudinal experimental studies in population groups:

Long term studies designed to evaluate the effect of prophylactic or therapeutic measures, or merely to study the development of gingivitis and subsequent periodontal destruction, represent another form of epidemiological research.

For those purposes, the Gingival Index (GI) of Silness and Løe (1964) is the index of choice. Combined with measurements of loss of attachment as described by Glavind and Løe (1967) at corresponding tooth surfaces, detailed information may be obtained. Russell's Periodontal Index (1956) and Ramfjord's Periodontal Disease Index (1959) may also be suitable for some long term studies of gingivitis and periodontal disease and the possibility of using periodic identical colour photographs should not be disregarded (Hazen 1974).
Gingival indices for controlled clinical trials in small groups:

This type of study is often used in the early stages of human experiments on drugs and other means of prevention or therapy for gingivitis. The choice of an index may depend on the relation of the accretions to gingival health and on the measurement of the inhibitory or cleansing effectiveness of an agent or procedure. The amount and location of accretions anticipated, especially when saturation of an index is likely to occur, is also of importance. Because of the small number of observations, very accurate assessments are necessary. Sophisticated index systems are often recommended. Efforts are made to control all known variables, except for the one to be tested.

Gingival indices based on visual changes of colour and form (PMA modified by Parfitt 1957, Suomi & Barbano 1968) are too subjective to be used for this type of experiment. The alternative use of a gingival bleeding scale with a dichotomous scale (Carter & Barnes 1974, Ainamo & Bay 1975) is too crude for a similar purpose and results in a reduction of sensitivity. The gingival bleeding indices with a proper severity scale (Mühlemann & Son 1971, Nowicki et al 1981) are also subjected to error from non-standardised probing forces of different examiners.

The Gingival Index takes into account both visual changes and bleeding tendencies. Overall, it has been shown to correlate fairly well with the histological picture of gingivitis in its very early stage. This allows investigators to let control groups develop gingivitis up to a well defined clinical level and then reverse it (Hazen 1974).
Gingival fluid measuring allows more objective criteria to be used. However, the method is very time consuming and limits itself to small scale trials.

**Gingival indices for periodontal treatment needs evaluations:**

As prevalence is the primary concern, the presence or absence of gingival bleeding is the most usual criteria for scoring gingivitis for periodontal treatment needs evaluation.

The Gingival Bleeding Index of Ainamo and Bay (1975) records the presence or absence of gingival bleeding on gentle probing with a blunt probe.

The WHO 1977 method (WHO 1977) scores "intense gingivitis" with the criteria of marked visual changes in the gingival colour, form and density, and/or gingival bleeding on digital palpation.

In an effort to reduce examiners' decisions and standardise the procedure in eliciting gingival bleeding, the Community Periodontal Index of Treatment was developed by WHO and FDI jointly (Ainamo et al 1982). It recommends the use of a special probe, the 621 periodontal probe (Emslie 1980), with a probing pressure of no more than 25 G to elicit gingival bleeding, as the only criteria for scoring gingivitis. No visual changes are recorded. The objectivity of the gingival bleeding criteria is enhanced by standardising the probe and probing force.

Indices for periodontal treatment needs will be further reviewed in Chapter 7 of this treatise.
6. INDICES FOR MEASUREMENT OF LOSS OR GAIN OF PERIODONTAL ATTACHMENT

6.1 INTRODUCTION

The periodontium, by definition, is the supporting system of the teeth and the two main purposes of periodontal therapy are to preserve or gain support for the teeth and to promote periodontal health (Ramfjord 1974).

It may be stated categorically, that none of the present periodontal indices will provide data with adequate details for studies and clinical trials involving loss or gain of periodontal attachment. Periodontal indices often combine gingivitis scores and other recordings into a composite score and are not suitable for specific evaluation of attachment levels.

The major diagnostic methods outlined by Ramfjord (1967, 1974) for the assessment of periodontal attachment loss were periodontal probing and roentgenography. Histometric measurements from histologic block sections of teeth and surrounding tissues can be made with a high degree of precision (Costich & Ramfjord 1968) but the measurements are limited to a specific time and seldom practicable for clinical trials.

Excised soft tissue may be useful for studies concerned with gingivitis, but provide very little information on loss or gain of periodontal support.
Loss of periodontal attachment is also sometimes assessed on the basis of mobility of teeth. However, there does not seem to be a consistent relationship between loss of periodontal support and mobility. Many teeth with severe periodontal disease may not be mobile at all. Conversely, it is recognised that a tooth may be mobile in the absence of active periodontal inflammation, and providing that the periodontal conditions remain stable, mobility per se is not a cause for concern. (Nyman & Lindhe 1976). Therefore, mobility as a diagnostic criteria is less important than probing and roentgenography (Chilton 1974). Only periodontal probing will be reviewed in this chapter.
6.2 PERIODONTAL PROBING

'The shallow groove around the tooth bounded by the surface of the tooth and the epithelium lining the free gingival margin' is the definition Glickman (1972) gave to the clinical feature he termed the 'gingival crevice'. The term 'gingival sulcus' has been used by Goldman and Cohen (1973), McPhee and Cowley (1975) and Page and Schroeder (1976). Shroeder and Listgarten (1971) defined gingival sulcus as 'the shallow groove between the tooth and the normal gingiva, extending from the free surface of the junctional epithelium to the gingival margin'.

The depth of this groove, 'the gingival crevice' or 'gingival sulcus' is used to indicate change from health to disease, but there are differences in opinion as to what depth demarcates the point of change. The pathologically altered gingival sulcus, lined to varying extents with pocket epithelium, is a pocket (Schroeder & Listgarten 1977).

Lövdal et al (1958) thought that the ideal pocket depth would be zero. They considered a crevice depth of up to 2.5 mm to be within the normal range whereas crevices more than 2.5 mm deep were thought of as pathological pockets.

Manson (1975), in his textbook, considered the normal crevice depth to be between zero and 2 mm, while Glickman (1972) said that the average normal, crevice depth is 1.8 mm. Many other writers have accepted as normal crevice depths ranging up to 3 mm (Marshall-Day et al (1955),
Goldman and Cohen (1973) and Oliver (1976).

From these studies, it would seem that the depth of the normal or healthy crevice spans a range from zero to 3 mm. The Current Procedural Terminology for Periodontics (American Academy of Periodontology 1977) indicates the range to be 1.5 to 2.5 mm.

Periodontal probing has been, and continues to be, one of the most useful diagnostic tools to determine the presence and severity of periodontal lesions. In addition to its traditional role as an instrument for estimating sulcus and pocket depths, the periodontal probe has been used to locate dental plaque (Silness & Löe 1964) and gingival inflammation (Löe & Silness 1963, Mühlemann & Son 1971) as well as to determine a variety of measurements and relationships including the approximate configurations of bony defects, the relationship of pocket depth to mucogingival junction, the width of the gingiva, and the extent of gingival recession (Warner & Sims 1982).

Reported methods of periodontal probing:
Ramfjord (1967) advised that the probe be placed against the enamel so that the angle between the working end of the probe and the long axis of the tooth is approximately 45 degrees. With light pressure the probe should be advanced in an apical direction maintaining contact with the tooth surfaces at all times. A change in surface texture should be detected when the probe moves from enamel to cementum. All measurements were rounded off by Ramfjord to the nearest millimeter, any measurement close to a half-millimeter was rounded to the lower
whole number. By assigning all doubtful measurements to the lower score, reproducibility is greater than if a more accurate determination of 0.5 mm were attempted (Ramfjord 1974). O’Leary (1967) like Ramfjord, stressed the importance of directing the probe tip along the crown towards the cemento-enamel junction at a 45 degree angle until the junction is located. The angle of the probe is then decreased so that the tip can reach the pocket base. The methods of Ramfjord and O’Leary both required the locating of the cemento-enamel junction since this position was used as a fixed landmark in their studies. This explains the use of the 45 degree angle with close initial placement of the tip of the probe to the enamel surface.

Findlay (1963) passed the probe gently between tooth and gingival margin until he felt the pocket base. The initial angle of the probe is not mentioned, but Findlay considered that the probe should be maintained in a position as parallel as possible to the long axis of the tooth, as did Gottsegen and Abzug (1963), Fuder and Jamison (1963) and Kumar et al (1966).

In any discussion on probing, the necessity of relating the gingival margin to the cemento-enamel junction is important. To ascertain the depth of the gingival crevice with a probe provides little information relative to the amount of attachment that has been lost. But to associate the crevice depth with the position of the gingival margin, as it relates to the cemento-enamel junction, furnishes important data regarding the status of the periodontal support (Hurt 1977).
Hassell et al (1973) and Hurt (1977) believed that the periodontal probe is a searching instrument which must be used to search the contour of the pocket and determine the deepest point. Merely inserting the probe once into the pocket is not adequate for objective evaluation of periodontal conditions (Hassell et al 1973).

The previous statement is true when probing for treatment purposes. However, in clinical trials, probing is often restricted to certain selected points at the gingival crevice for the sake of reproducibility. These measurements may be repeated over a number of years in longitudinal clinical trials (Suomi 1974).

A reproducibility test should be repeated, prior to institution of a study, until satisfactory results are achieved (Glavind & Løe 1967, Smith et al 1970).
6.3 PROBLEMS RELATED TO PERIODONTAL POCKET DEPTH MEASUREMENTS

For many years it was assumed that periodontal probing provided the dentist with the means of determining the actual depth of the sulcus or pocket as it appeared in histologic tissue sections. This has now been repudiated by the histologic studies of Schroeder and Listgarten (1971), Armitage et al (1977) and Polson et al (1980).

An increasing number of investigators have now become concerned with the interpretation of periodontal probing in relation to periodontal anatomy both in health and disease. It is now generally agreed that periodontal probing can be an imprecise technique as there are a number of variables that may combine to invalidate measurement. These variables include probing force, degree of inflammation of periodontal tissues, probing techniques, probe thickness, shape of the probe tip, accuracy of markings on the probe, inability to read accurately the graduations on the probe, angulation of insertion, site at which measurements are taken, local anatomical factors, presence of subgingival calculus and cavities, overcontoured restorations and the pain reaction of the patient.
6.3.1 Influence of Periodontal Probing Force on Pocket Depth Measurement

It has been shown that the amount of force exerted during periodontal probing exhibits a positive correlation with the depth of probe penetration. (van der Velden & de Vries 1978, van der Velden 1979, van der Velden & Jansen 1981). This finding suggests that controlling the amount of force during probing may result in more consistent measurements of attachment level. Based upon this assumption, much data has been presented regarding the 'ideal' forces to be used in probing. (van der Velden 1979, 1980, van der Velden & Jansen 1981, Garnick et al 1980, Hancock & Wirthlin 1981, Polson et al 1980, Robinson & Vitek 1979).

Gabathuler and Hassell (1971) in a study designed to quantitate probing forces, developed the first pressure sensitive probe. The results of their study, utilising eight clinicians, indicated forces ranging from 20.2 to 32.6 ponds.

Another pressure sensitive probe was developed by van der Velden and de Vries (1978). Results using this probe showed an increasing pocket depth with increasing probing force. Mean pocket depths increased from 2.08 mm at 0.15 N to 3.71 mm at 0.75 N. Testing showed the differences to be statistically significant. Proye et al (1982) found a consistent increase in probing depth and bleeding tendency as probing force increased.
Freed et al (1983) using a pressure sensitive probe, investigated the range of probing force used by 58 practitioners and found it to be between 15 and 125 G. Probing depth differences between 15 and 50 G force ranged from 0.69 to 0.93 mm for the study.

A relatively broad intra-examiner range with a mean of 43.9 G was also recorded. Intra-examiner variations in probing forces may be influenced by access to the area probed. Anterior teeth which offer greater accessibility, were consistently probed with less force than posterior teeth. Distal units in the posterior segments were probed with the greatest amount of force while facial units of anterior teeth were probed with the lightest force in a study by Freed et al (1983).

Another recent study has shown that probe measurements on the distal surfaces of teeth and the posterior segments of the mouth tend to be more variable (Goodson et al 1982). Impaired vision the necessity of retracting tissues, and compromised instrument position may reduce tactile sense in the posterior segments of the dentition.

A further possible explanation for intra-examiner variations in probing force is that clinicians 'learn' to use different magnitudes of force in different areas. The clinicians may probe with greater force in the inter-proximal areas in an attempt to 'search out possible lesions due to the propensity of the area for periodontal disease. Gabathuler and Hassell (1971) noted that clinicians used a greater force when entering the crevice or searching for the deepest portion.
Van der Velden and de Vries (1978) called for a standardisation of probing force in measuring pocket depth and bleeding tendencies. They recommended a probing force of 0.75 N as optimal with probes of 0.63 mm diameter (1979). Other investigators (Armitage et al 1977, Robinson & Vitek 1979, and Garnick et al 1980) regarded a force between 10 and 25 ponds to be in the mid 'range of gentle' probing forces as determined by experienced clinicians.

Current opinion is that loss of periodontal attachment is best determined using light probing pressure of approximately 8 to 12 G; which does not produce blanching of the tissues (Holborow et al 1983). To obtain consistent clinical or research data, it is imperative that probing forces be standardised.

Hassell et al (1973) noted only a low correlation between the depth recorded by the probe and the force applied to it. They reported that probing technique appears more important than the force applied. However, they stressed, that the application of a heavy force is definitely contra-indicated. The discrepancies in pocket depth measurements in their study resulted from the fact that different investigators measured different areas of the same pocket.

Hassell et al (1973) believed emphasis should be placed upon probing techniques i.e. slow, deliberate 'searching' probing of each area of each pocket; if clinical evaluations are to be well correlated to the condition in reality. Vitek et al (1979) also considered searching for the deepest pockets is more important in diagnosis than refining
the amount of pressure applied to the probe. Under-estimation of pocket depth could result from inadequate positioning of the probe, particularly with respect to angulation. (Ziegler & Allen 1978). Over-estimation could result from excessive force used.
6.3.2 Influence of Periodontal Probe on Pocket Depth Measurements

Probing measurements are influenced by the design of the probes.


The design of periodontal probes vary in such factors as the material, size, weight, cross-section shape and thickness of the blade, shape of the probe tip, angulation and in the form of calibration. (Tibetts 1969, van der Velden 1978). Different investigators have used probes of various designs in their studies.

Löe (1979) listed the desirable properties of an ideal periodontal probe:

1. The measurement design must be easily manipulated in the oral cavity with minimal discomfort and minimal trauma to the tissues.
2. It must allow probing forces to be controlled.
3. It must be sterilizable.
4. The probe terminal diameter is to be 0.35 mm; the thickness of the blade 0.8 mm.
5. The sensitivity of the probe should be 0.1 mm for linear measurements and from 0 to 15 mm.
6. The calibration of the probe must be accurate and clear to allow easy reading of the mm markings.

Numerous types of periodontal probes are commercially available. The Merritt, Gilmore, Williams and the University of Michigan probes are of the round type in cross-sectional shape, whilst the Goldman-Fox, Drellich, Nabers and Hu-Friedy probes are flat or rectangular.

Combinations are also available eg. the Goldman-Fox/Williams instrument has a round probe at one end and a rectangular one at the other.
Special pressure sensitive probes were designed to investigate the relationship between probing force and tissue penetration by the probe. Other investigators have made special probes or modified existing probes to obtain readings to 0.5 mm (Dragoo & Sullivan 1973, Nelson et al 1977). Detsch (1980) developed a periodontal probe which utilizes a vernier gauge to permit direct measurement to 0.1 mm.

Ramfjord (1974) reports, the thinner the probe, the better is the reproducibility since such probes will penetrate to the bottom of the epithelial attachment without a pain signal from the patient, while a thick probe will press against the connective tissue wall of the epithelial attachment and cause discomfort at an indefinitely defined stop. Coppes (1972) and Pritchard (1978) in their studies, noted that the University of Michigan probe causes patient discomfort, with consequent risk of under-estimating pocket depth.

Schmid (1967) reported that flexible plastic periodontal probe tips were better in adapting to periodontal pocket morphology than metal probes. However Sanderink et al (1983) found they had no marked clinical advantages in measuring pocket depth over the metal probe.

Calibration of periodontal probes:

Two factors which directly influence the reproducibility and reliability of pocket depth measurements are accuracy and mode of calibration of the periodontal probes.
Glavind and Løe (1967) measured pocket depths of all surfaces of 1530 teeth and showed that the method error was less than ± 0.5 mm. Since this small error was not clinically significant, the millimeter was considered to be an appropriate unit of measurement for recording pocket depths and loss of epithelial attachments. Yet in epidemiologic studies probes are often used without continuous millimeter markings.

The most common calibration of periodontal probes is as follows: the probe is marked in 1 mm measurements up to 10 mm, but the 4 and 6 mm marks are omitted to facilitate reading the measurement (e.g. the Merritt, Williams, Goldman-Fox, and Naber probes). The University of Michigan #1 periodontal probe has a full range of mm increment markings.

Van der Velden (1978) reported that only 60 percent of 4 and 6 mm pockets were read correctly in vitro when using a probe which omitted the 4 and 6 mm marks when compared to 90 percent with nearly all other pocket depth measurements. This was due to under-estimation of pocket depths in the 4 and 6 mm area. This under-estimation causes difficulty in evaluating the outcome of periodontal treatment. Also in epidemiological investigations the under-estimation will influence the results obtained. Van der Velden (1978) stated that it is better not to use a probe where the 4 and 6 mm marks are omitted, since unreliability will occur with any probe where these 2 marks are omitted.

Winter (1979) collected all periodontal probes used by five periodontists and measured their millimeter markings for accuracy. He
found that most probes were not precise, especially those manufactured by Hu-Friedy prior to 1976. The new Williams and Michigan probes were the most accurate. Variations in length of commercial probes have also been noted by other researchers (Vincent et al 1976, Nelson et al 1977). Detsch (1980) found a commonly used periodontal probe varied as much as 0.3 mm for the first millimeter increment. The variation was thought to be due to the lack of precision in polishing the tips of the probe during manufacture. Wear of the tips did not appear to be significant (Winter 1979). Indistinct millimeter marks on some new Merritt probes were also reported by van der Velden in 1978.

It can be concluded that periodontal probes bought at different times and through different manufacturers show a wide range in the accuracy of the millimeter markings. In view of this, Ramfjord (1974) said that one should not have to purchase new probes during an investigation, especially if it is a longitudinal study. Ramfjord (1974) also suggested for research purposes that it is better to have probes specially made or selected out of a large stock rather than the random buying of probes over the counter.

Periodontal probes with inconsistent markings may occur in any private practice or in clinics and may affect decisions made by clinicians on treatment plans and changes as a result of therapy.
6.3.3 Influence of Periodontal Health on Pocket Depth Measurements

The possibility that periodontal probing does not record the actual depth of the sulcus or pocket as it appears in histological tissue sections was suggested by Schroeder and Listgarten (1971). They felt that probing may result in tissue penetration by the probe with a consequent over-estimation of actual sulcus or pocket depth. In a later paper, Listgarten (1972) indicated that the extent of tissue penetration is dependent on the degree of inflammatory cell infiltration and accompanying loss of collagen fibres.

Saglie et al (1975) documented a zone of partially destroyed connective tissue fibre existing between the most apical remnants of the junctional epithelium and the most coronal extension of intact connective tissue fibre retained on the root surface of periodontally involved teeth. 'Established' or 'advanced' periodontal lesions in this region, in addition to the numerous cells which contribute to the inflammatory infiltrate are, characterised by marked loss of collagen fibres (Page & Schroeder 1976). A periodontal probe may encounter little resistance in passing through a junctional epithelium markedly infiltrated with inflammatory cells or a connective tissue in which collagen fibres have been lost (Listgarten 1980).

Saglie et al (1975), Silverston and Burgett (1976), Listgarten et al (1976), Spray et al (1978) and Powell and Garnick (1978) are all in agreement that the probe tip in inflamed tissue stops at the level of intact connective fibres, that is approximately 0.25-0.4mm apical to the termination of junctional epithelium. This is also in agreement
with the conclusions of van der Velden (1979). This was due to the zone of partially destroyed fibres located beneath the junctional epithelium (Listgarten 1980).

Histometric measurements carried out by Armitage et al (1977) indicated that the relationship of the probe tip to the most apical extension of the junctional epithelium varied depending on the degree of inflammation of the gingival tissues. In the presence of gingival health, the probe consistently failed to reach the apical termination of the junctional epithelium by 0.4 mm. In the gingivitis group, the probe tip fell short of the apical termination of the junctional epithelium by 0.1 mm. In the periodontitis group, the probe tip passed beyond the apical termination for a mean distance of 0.25 mm. They also indicated that the discrepancy between the two measurements is likely to be least in the presence of a healthy periodontium and greatest in the presence of chronic periodontitis.

Robinson and Vitek (1979) showed a linear relationship between the Gingival Index (GI) and the resistance of the gingival tissues to probe penetration. With 30 pond probe pressure the mean penetration at GI=0 was 0.30 mm coronal to the connective tissue attachment, the mean penetration was 1.25 mm apical to the connective tissue attachment at GI=3.

It is apparent that in most of the studies cited, the probing measurements seldom correspond to the histologic sulcus or pocket. It is also apparent that in the presence of a healthy, shallow sulcus, the probing measurement more often approaches the anatomic sulcus depth.
than in the presence of gingivitis or periodontitis. The discrepancy appears to be due to increased tissue penetration by the probe with increased accumulation of inflammatory cells in the tissues. Conversely, as the inflammatory infiltrate decreases following periodontal therapy, there is a concomitant deposition of new collagen which provides the tissues with greater resistance to probe penetration (Listgarten 1980).

**Clinical significance:**

In view of the results of clinical investigations related to probing and the current knowledge of the histopathology of periodontal disease and the healing of periodontal lesions following therapy, a re-evaluation of probing is in order. This re-evaluation should encompass the interpretation of probing depth measurements during the initial examination of a patient with periodontal disease, the role of probing in treatment planning and its value in monitoring the effects of various modes of therapy (Listgarten 1980).

In the new patient with untreated periodontal lesions, probing depth measurements will tend to over-estimate the anatomic sulcus or pocket. This error is likely to be between 1-2 mm. The reduction in probing depth noted following initial therapy may represent an increased tissue resistance to probe penetration brought about by a reduction in the size of the inflammatory infiltrate and an augmentation of the density of collagen fibres, while the traditional concepts of new attachment and tissue shrinkage may play lesser roles. Therefore, probing depth measurements obtained following initial therapy are
likely to give the clinician a more accurate estimate of the true location of the pocket bottom than obtained by pre-operative measurements (Warner & Sims 1982). It is critical to re-evaluate probing depth measurements following initial (non-surgical) therapy and before any decision is made to proceed with surgical pocket elimination.

Oliver (1970) states that pocket depth per se does not indicate that periodontal destruction is occurring but for lack of a better method we depend upon it to assess periodontal disease. Listgarten (1980) in his review of periodontal probing stated that, despite the uncertainties of interpreting probing depth measurements, the periodontal probe continues to provide the clinician with a simple and relatively reliable means of evaluating the relative periodontal status of a dentition.

Until more precise and acceptable methods are devised to predict destructive periodontal disease activity, periodontal probing continues to be the most useful diagnostic tool to determine the presence and severity of periodontal lesions.
7. INDICES FOR MEASUREMENT OF PERIODONTAL TREATMENT NEEDS

7.1 INTRODUCTION

Epidemiological studies have given substantial information about prevalence and severity. However the value of this data is limited in determining the need for periodontal treatment. Greene (1967) in discussing this situation stated it is not simple to find a 'conversion' factor by which epidemiological data could be converted into treatment needs.

The ability to convert commonly used and tested periodontal indices into treatment needs and the time required for treatment would be of considerable use to planners and administrators. However, none of the indices have provided for the public health planner anything but the most peripheral information about treatment needs - only the most crude and non-specific inferences about treatment needs can be drawn from these measurements (Barmes 1976).

What a public health planner wants from any disease assessment is a means of evaluating existing services and estimating present and future service needs for both preventive and curative programmes. He wants to take a data summary and use it as the mathematical base for manpower calculations dealing with deficiencies, surpluses, maldistribution and future requirements. He wants data to be reliable and comprehensive enough for him to calculate with good precision, according to the various services indicated or possible, how many persons can be cared for by each operator (Barmes 1976).

1. The criteria are too subjective and their sensitivity and specificity is questionable.

2. The criteria for treatment are insufficiently flexible, they do not allow for variations in treatment philosophies.

3. Some treatment modalities require scientific longitudinal studies.

4. None of the systems include demographic or behavioural criteria.

An index designed to measure treatment need requirements for periodontal disease should possess the attributes of any good index. In addition, it should provide a measurement of time needed for the complexity of treatment to serve as a basis for calculating manpower requirements and cost estimates for the delivery of care (Horowitz 1979).

An ideal index of population treatment needs according to McPhee (1977) should include:

1. A measurement of the requirement for preventive measures.


3. A measure of the requirement for treatment of destructive periodontitis.

4. A measure of the occlusal status of the individual of progression of periodontitis with respect to (2) and (3) above.
To establish optimally reliable and useful methods for the assessment of periodontal status and treatment needs, should blend the skills of the specialist clinician and the epidemiologist (Barmes 1976).
7.2 WHO 1971 - ORAL HEALTH SURVEYS - BASIC METHODS


On the basis of a rapid examination of the full mouth, using only a mouth mirror, scores of 0, 1 and 2 were given for normal, gingivitis and periodontitis respectively. The criteria of scoring were similar to the Periodontal Index of Russell (1967). The only assessment of treatment need was for the number of teeth requiring extraction for periodontal reasons.

This method of assessing periodontal disease was overly crude. Gingivitis was recorded based only upon an impression of inflammation obtained from a 'first glance'. A decision was made on the presence of periodontal pocket without the use of a periodontal probe. No information was provided for the purpose of treatment planning because the intensity of the disease was not recorded (Horowitz 1979).

Barmes (1976) stated that the stark percentages of samples having gingivitis or periodontitis were too crude a treatment need indicator for most administrators. Davies et al 1974 found poor reproducibility and it appeared that this was as big a problem as the disease status and treatment assessment difficulties.
7.3 THE PERIODONTAL TREATMENT NEEDS SYSTEM (PTNS)

This system was developed by Bellini and Johansen (Bellini 1973, Johansen et al 1973) to determine periodontal therapeutic needs of populations by estimating types of treatment needed and the time required for performing it; thus enabling the calculation of manpower requirements and costs. Subjects are classified into 3 treatment classes using a mouth mirror and a periodontal probe for all gingival areas on each tooth. Any quadrant with a pocket deeper than 5 mm is scored C. Where there are gingivitis, overhangs and calculus but no pockets, B is scored. When only plaque and gingivitis are present, the score is A. By estimating the number of quadrants in each class, the estimation of treatment time can be made:

<table>
<thead>
<tr>
<th>PTNS Class</th>
<th>Treatment Required</th>
<th>Time allotment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No treatment</td>
<td>0</td>
</tr>
<tr>
<td>A</td>
<td>Motivation and oral hygiene instruction</td>
<td>each patient 60 minutes</td>
</tr>
<tr>
<td>B</td>
<td>Above and scaling</td>
<td>each quadrant 30 minutes</td>
</tr>
<tr>
<td>C</td>
<td>Above and surgery</td>
<td>each quadrant 60 minutes</td>
</tr>
</tbody>
</table>

Because various treatment procedures are estimated separately, the PTNS lends itself to planning the employment of different categories of dental health personnel and analysis of costs (Bellini 1973). Johansen et al (1973) found the PTNS to be reproducible and sensitive for predicting treatment needed and the time for treatment. McPhee (1977) commented that no attempt is made to define priority of treatment between groups. Probing all gingival areas for pockets may be too lengthy a procedure for screening large populations. It is still an unproven assumption that all pockets in excess of 5 mm require surgical elimination (McPhee 1977).
WHO 1977 - ORAL HEALTH SURVEYS - BASIC METHODS

In the second edition of Oral Health Surveys - Basic Methods (WHO 1977), the mouth is divided into six segments and the presence of soft deposits, calculus, intense gingivitis and advanced periodontal involvement is recorded for each segment. The WHO 1971 method in the first edition recorded the presence of certain conditions related to periodontal involvement that used the entire mouth as a unit. Therefore, the revised method is more sensitive. Moreover, the criteria are more definitive in the second edition than in the first edition.

With regard to instrumentation, the presence of soft deposits is detected only with the use of a mouth mirror; a probe is not used. Calculus is recorded for a segment when it 'is obviously present'. A probe is used for calculus detection only to confirm that a deposit is calcified. Intense gingivitis is recorded if there is a marked change in gingival colour or if firm digital palpation causes bleeding. The examiner is cautioned, however, to avoid digital palpation if it is believed that the manoeuvre will 'undoubtedly cause bleeding'. Advanced periodontal involvement is recorded when there is definite tooth mobility or if a periodontal pocket greater than 3 mm in depth is present that is accompanied by either intense gingivitis, marked changes in gingival contour, suppuration or advanced gingival recession with exposure of cementum. If mobility is not present, a periodontal probe is used to check for a periodontal pocket only if one or more of the four necessary accompanying conditions is present.
In the combined oral health and treatment requirement portion of the 1977 edition, each subject is further classified into one of six categories of treatment requirements based on the oral examination.

1. no treatment necessary
2. oral hygiene instruction
3. prophylaxis and oral hygiene instruction
4. periodontal therapy without extraction of any teeth for periodontal reasons
5. treatment which includes the extraction of one or more, but not all teeth for periodontal reasons
6. full extraction

Deficiencies of the method:

The 1977 manual openly admits to accepting compromises in criteria for both the assessments of periodontal status and the need for treatment. The compromises were conceded so as to reduce the inter- and intra-examiner variations to a minimum.

McPhee (1977) criticized the term 'intense gingivitis' as complicating an already unnecessary complex terminology of gingivitis. The criteria for 'intense gingivitis' defined do not distinguish contained gingivitis from the aggressive and the destructive lesion any more than any of the established traditional criteria. McPhee (1977) also stated that the criteria for advanced periodontal involvement is open to a number of criticisms. For example, tooth mobility is a bad parameter of quantitative loss of support and destruction of periodontal tissue. Also significant tissue destruction and pocket formations may exist in the absence of tooth mobility or any of the four conditions said to be accompanying pocketing in the manual.

Periodontal pockets are determined on the basis of suppuration, or the presence of intense gingivitis that has extended into the area of the
attached gingiva, although there may not be universal agreement that
the latter criterion is definitive for the presence of a pocket
(Horowitz 1979).

A gingival crevice of 3 mm in Horowitz's opinion (1979) is too shallow
to regard as evidence of advanced periodontal involvement even if
accompanied by another sign of involvement.

Horowitz (1979) also stated that it was not possible to compute time
requirements for care which should be an integral component of an
index for treatment needs. For example, subjects who are classified
as requiring full extractions for periodontal disease may be treated
more easily in less time than those who require only a few or no
extractions.

Cutress et al (1977) compared the WHO 1977 method of periodontal
assessment to the Periodontal Index of Russell, and the Oral
Hygiene Index of Greene and Vermillion. They found that the PT and
OHI were more objective, quantitative and sensitive than the WHO 1977
method. Much difficulty of examiner calibration was experienced in
diagnosing 'intense gingivitis'. Examiners considered it particularly
misleading to score positive for intense gingivitis for a segment
where only one inter-dental unit was involved, quite commonly
associated with a restoration.
7.5 COMMUNITY PERIODONTAL INDEX OF TREATMENT NEEDS (CPITN)

From the review of literature, it is obvious that there had been much dissatisfaction with the existing basic methods of measurement of periodontal treatment needs in both individual patients and population groups. Realising this situation, WHO in 1977 summoned a group of experts from 14 FDI member countries who conducted a comprehensive review of current literature. The resulting recommendation based on a combination of the sextant approach by O'Leary et al (1963), the Periodontal Treatment Need System (Johansen et al 1973) and the principal of using dichotomous criteria for periodontal disease indicators (Ainamo & Bay 1975), resulted in the development of Community Periodontal Index of Treatment Needs (CPITN) which was explicitly designed for rapid assessment of both prevalence and treatment needs of periodontal disease.

Although termed the Community Periodontal Index of Treatment Needs, it is also readily adaptable for individual dental patients. A thorough periodontal examination is time consuming and may be difficult to carry out for every dentate patient. Treatment time can be estimated and appointments can then be scheduled.

The final recommendation for scoring the CPITN was published in 1982 by six members of the Joint FDI/WHO group (Ainamo et al 1982).
7.5.1 Methodology of the CPITN

The CPITN is based on the examination of six segments of the dentition, from second molars to first premolars and from canines to canines. Although each tooth is examined, only one recording is made for each of these sextants. Severity gradings are avoided in favour of a single present/absent classification.

Each sextant contains the following teeth:

<table>
<thead>
<tr>
<th>17 - 14</th>
<th>13 - 23</th>
<th>24 - 27</th>
</tr>
</thead>
<tbody>
<tr>
<td>47 - 44</td>
<td>43 - 33</td>
<td>34 - 37</td>
</tr>
</tbody>
</table>

In epidemiological surveys for assessment of periodontal treatment needs on a population level the recordings per sextant are based on findings from specified index teeth.

The index teeth examined are:

<table>
<thead>
<tr>
<th>17, 16</th>
<th>11</th>
<th>26, 27</th>
</tr>
</thead>
<tbody>
<tr>
<td>47, 46</td>
<td>31</td>
<td>36, 37</td>
</tr>
</tbody>
</table>

Although 10 index teeth are examined, only 6 recordings, one relating to each sextant, are made.

The use of a special WHO designed periodontal probe, the 621 periodontal probe (Emslie 1980) is recommended: (Figure 1, page 82).

The probe has the following specifications:

1. It is made of metal with a knurled handle of diameter 3.5 mm and a maximum weight of 4.5 g.

2. It has at the working tip a sphere of 0.5 mm diameter, the probe has a minimum diameter of 0.25 mm at the neck where the sphere is attached.

3. It has a colour coded area between 3.5 and 5.5 mm from the ball pointed tip.
The lightness and the spherical tip are characteristics of particular importance for detection of subgingival calculus and to ensure minimal trauma when probing the gingival sulcus. The contra-angle reduces the twisting movement when probing for calculus and the knurling of the shaft permits a very gentle grip to be employed. (Emslie 1980)

A tooth is probed to determine pocket depth and to detect calculus and bleeding response. The probing technique recommended for measuring pocket depth is a working force of no more than 25 G with the ball pointed tip following the anatomic configuration of the root surface. A practical test for establishing this force is to gently insert the probe point under the finger nail without causing pain or discomfort.

If the colour coded area disappears into the pocket during probing, the pocket depth is 6 mm or more and gives a sextant a code of 4. If the colour coded area remains partly visible, the pocket depth is 4 or 5 mm and code 3 is given. If the entire coloured band remains visible, code 2 is given if supragingival and/or subgingival calculus is present. Code 1 is recorded if the pocket depth is 3 mm or less and there is no calculus but bleeding on gentle probing of the pocket or sulcus occurs. Absence of any sign of disease in a sextant qualifying for recording (two or more functioning teeth) is indicated with code 0.
Disease status codes are converted into four treatment categories:

Complex treatment (III) for sextants with 6 mm or deeper pockets from code 4;

Scaling (II) from codes 3 and 2;

Improvement of personal oral hygiene (I) from code 1;

No treatment (0) for absence of disease.

It should be noted that treatment category III also requires treatments II and I; and treatment category II also requires treatment I.

There is no rule specifying the number of separate probings to be made. When index tooth or teeth are being examined or when the recording is based on the worst finding in all teeth of the sextant, it would be rare to exceed four probings per sextant (Ainamo et al 1982). The time needed for the CPITN in recording the codes for the sextants should not exceed 1-2 minutes.

Ainamo et al (1982) considered that the use of any periodontal probe does not provide the clinician with accurate measurements of pockets in millimeters which, even if feasible, are of doubtful value. Instead, the probe measures what is 'normal' and 'abnormal' with indications of treatment requirements being derived from 'abnormal' scores. A force of no more than 25 G using the WHO probe is considered sufficient for the detection of a re-infected long epithelial attachment and to elicit bleeding from the areas of inflammation. The sign for inflammation is bleeding after such probing. The use of a standard force for probing is essential and critical to the successful use of the CPITN or any other modern system for evaluation of periodontal health. (Ainamo et al 1982).
It was emphasized that the CPITN does not provide an assessment of past periodontal disease experience. It does not record gingival recession since it does not generally affect treatment needs because they are not usually reversible (Ainamo et al 1982).

7.5.2 Utilisation of CPITN Data

The CPITN is designed for rapid and practical assessment of various periodontal treatment needs in population surveys and for initial screening of patients attending for regular dental care.

For individual patients requiring oral hygiene instruction and scaling only, the CPITN recordings are sufficient for treatment planning. A finding of the need for complex treatment necessitates a more precise identification of the teeth and tooth surfaces affected before starting the actual therapy required by the individual patient.

For evaluations of periodontal treatment needs in a population and for planning purposes, the CPITN recordings can be utilized in different ways.

1. Average severity scores can be obtained by examination of index teeth or all teeth for the presence of deep or moderately deep pockets, calculus or bleeding in the population (Ainamo et al 1982).

2. Treatment needs are better reported as the number or percentage of subjects in various age groups in each treatment need category (Ainamo et al 1982). WHO (1978) recommended periodontal assessments should be reported for four different age groups: 15-19, 20-29, 30-44 and 45-64 years. The 15-19 were chosen because it is the earliest age at which all populations have a fully erupted complement of permanent teeth. Besides this age group is particularly appropriate for programme monitoring in the period 1980-2000 as this group will be of age 35-39 years at the end of this
period. Data for age group 30-44 years is used to indicate the general magnitude of the periodontal problems in adults. Thus data collected now for the two age groups (15-19) and (30-44) will be a valuable baseline for evaluating preventive and care programmes over this 20 year period (Barmes & Sardo-Infirri 1981).

3. It is often useful to present the mean number of sextants with bleeding, calculus, moderate pockets or deep pockets for each age group (Ainamo et al 1982).

4. Alternatively, reporting the number and percentage of individuals with (a) no sextants scoring 0, 1 etc. (b) 1-2 sextants scoring 0, 1 etc. (c) 3-4 sextants scoring 0,1 etc. (d) 5-6 sextants scoring 0, 1 etc. would facilitate identification of high and low risk groups and priorities for treatment (Ainamo et al 1982).

5. Another approach is to report the results as the average time needed to carry out the procedures in the various treatment categories. Further research is under way before the release of more detailed recommendations (WHO 1978).

The strength of the CPITN lies in its ability to dissect the polarization of disease within different strata of the population. The dental health administrator can be better served by information about the proportions of individuals within various age groups having different levels of periodontal problems.

A complication factor in the evaluation of community programmes for prevention of periodontal disease is the rarity of a totally healthy periodontium. An often raised question is what level of periodontal health or disease is acceptable at a given age with a known dentist to population ratio.

In an attempt to answer such a question, Ainamo (1983) recently proposed tentative goals for periodontal 'health' in Europe for the year 2000. As a realistic goal, it was suggested that 90 percent of the 18 year olds and 75 percent of the 35-44 age group should have at
least three out of six sextants free of gingivitis and periodontal disease as judged by the CPITN. For age 65 and over, less than 10 percent should have deep pockets of 4 mm or more.
To meet the main objectives outlined in the introduction, the literature was reviewed and specific objectives were determined. A series of clinical studies was designed and carried out in three different sample populations to achieve these objectives.

The clinical studies consisted of a main study carried out on 200 consecutive subjects aged 15 years and over who presented themselves at Assessment & Diagnosis at Westmead Centre Dental Clinical School during the study period. Another clinical study was carried out concurrently with the main study on a sample population of 40 subjects aged 6-14 years at Assessment & Diagnosis. The third study involved examination of 90 first year dental students at the University of Sydney.

The clinical studies were carried out only after a preliminary study period. It was essential for the writer to be trained in using the 621 periodontal probe, probing pressure, probing technique, areas to be probed and the general examination procedure in using the CPITN index. The preliminary study period was spent under the supervision of Dr. J. Pritchard, Head of the Periodontic Unit.
Specific objectives:

The specific objectives for the studies are listed within the main objectives.

1. To determine the suitability and reliability of the CPITN index in measuring periodontal status and treatment needs, generally assess difficulties in the use of the index and to obtain some data on periodontal status and treatment needs in sample populations in Sydney, Australia. The specific objectives were:

   (a) To use the index to measure periodontal status and treatment needs in a group of 200 consecutive patients aged 15 years and over, in a sample population of 40 subjects aged 6-14 years and first year dental students.

   (b) To assess periodontal treatment requirements for 4 separate age groups recommended by WHO for subjects 15 years and over.

   (c) To determine intra-examiner variation on a patient, sextant and tooth basis.

   (d) To determine inter-examiner variation on a patient, sextant and tooth basis.

2. Variations in methods of assessment using the CPITN index.

   (a) To test the effectiveness and reliability of partial mouth recording using 10 index teeth compared to full mouth recording.

   (b) To estimate average time required for partial and full mouth examinations.

   (c) To test the effectiveness of two (2) probings for each of the index teeth in measuring prevalence and severity when compared to four (4) probings for each of the index teeth.
(d) To compare periodontal status using 6 index teeth (without 2nd molars) with 10 index teeth in subjects under 20 years; in the 15-19, and 10-14 age group and in the 18 year old dental students.

(e) To compare periodontal status using 6 index teeth with periodontal status using 6 index teeth without distal probings of first molar in subjects 15-19 years.

3. Feasibility of using the CPITN index for routine periodontal screening and evaluation in Westmead Centre Dental Clinical School.

(a) To compare the periodontal status of patients examined (using the CPITN index) with the qualitative periodontal assessment carried out by dental officers in the Assessment & Diagnosis department.

4. Comparison of the CPITN index with the previously recommended WHO index (Oral Health Surveys: Basic methods 2nd ed. WHO 1977) in subjects 15 years and over, subjects under 15 years and first year dental students.

(a) To compare the results of CPITN and WHO (1977) assessments.

(b) To determine intra- and inter-examiner variation using the WHO index.
9. METHOD

A protocol for the intended clinical study at Westmead Centre Dental Clinical School was submitted to the Research Committee for approval. Permission was granted to use the CPITN Index to assess a consecutive sample of patients attending the Assessment and Diagnosis Department. Following a preliminary study period, samples of 200 patients over 15 years of age and 40 patients 6-14 years were examined.

Periodontal status and treatment needs of ninety first year dental students were assessed at the University of Sydney. All first year dental students routinely had an annual clinical examination of their dental status by graduate dental public health students supervised by Associate Professor P.D. Barnard.

9.1 PRELIMINARY STUDY

A four week period from the 16th April to 11th May was spent at the Periodontic Unit, Westmead Dental Centre, to familiarise the writer with the use of the 621 periodontal probe, probing pressure, probing technique, areas to be probed, and the general examination procedure in using the CPITN Index. Sixty patients attending the Periodontic Unit for treatment were examined under the supervision of Dr. J. Pritchard, Head of the Unit. Inter-examiner calibration was also carried out with Dr. J. Pritchard. Preliminary intra-examiner duplicates were carried out by the writer on graduate dental public health students and some of the staff from the Periodontic Unit.
Since pressure sensitive probes were not available, probing pressure was practised by placing a probe blindly on a gold scale until such stage that the writer was exerting a force of no more than 25 g. Pressure was also tested by inserting the probe point under the finger-nail. If pain or discomfort was experienced, it was an indication that too much force was applied.

The WHO 621 periodontal probes used were manufactured by Morita. A sample of 16 probes used during the survey was checked for accuracy of markings when viewed under an Olympus Steri microscope (model SZ-III) at 25 x magnification. Markings were measured to 0.1 mm with the probe placed on a graticule. Figure 1 shows the 621 probe.

The colour coded area should be between 3.5 mm (i.e. lower markings of the coloured area) and 5.5 (i.e. upper marking of the coloured area) from the end of the probe. The range of probe measurements for the lower marking was 3.4 to 3.6 mm with a mean of 3.50 mm ± 0.05 mm (standard error (SE) ± 0.01 mm). The upper marking measurements ranged from 5.4 to 5.6 mm except for one measurement of 5.1 mm and the mean measurement was 5.47 mm ± 0.12 mm (SE ± 0.03 mm). The range of measurements for the colour coded area was 1.9 to 2.1 mm except for one measurement of 1.5 mm. The mean was 1.97 mm ± 0.14 mm with a SE of ± 0.04 mm.

Recorders to be used for the clinical studies were briefed on the sequence of examination, general examination procedure and the method of recording.
Figure 1   Diagram of WHO 621 periodontal probe
Figure 2  Form used for CPITN clinical studies

Westmead Centre Dental Clinical School  
Department Of Preventive Dentistry  
P. D. Barnard  S. Silva

Date    Examiner

Country Of Birth
Reason Not Been
A&D Assessment

PERIODONTAL STATUS AND TREATMENT NEEDS

**CPITN INDEX**

<table>
<thead>
<tr>
<th>17</th>
<th>16</th>
<th>15</th>
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</tr>
</tbody>
</table>

(Columns represented as B, L)

- **Duplicate Status**
  - B
  - L

- **Treatment**
  - B
  - L

The scoring is a 0 — 4 scale as follows:
0 = absence of any disease
1 = presence of bleeding
2 = presence of sub or supra gingival calculus
3 = presence of 4-5 mm pockets
4 = presence of 6 mm pockets

**WHO 1977 Index**

**PERIODONTAL STATUS**

- Absent = 0
- Present = 1

**PERIODONTAL TREATMENT REQUIREMENTS**

- **NONE**
- **Oral Hygiene Instruction**
- **Prophy and OHI**
- **Periodontal therapy**
  - (extraction)
- **Treatment with 1 or more extraction**
- **Full extraction**

**NOTES:**  
Central segments include incisors and canines, left and right segments include molars and premolars.
A survey form was developed to record the periodontal assessment and treatment requirements of each patient. The layout of the form is shown in Figure 2 and provision was made to record the following information:

**Examination details:**

On the top left hand side of the form was space for:

1. date of examination
2. name of the examiner

**Personal and demographic information:**

On the top right hand side was a space for patients identification adhesive label which contained:

1. patient's name
2. hospital registration number
3. date of birth
4. sex
5. telephone number

**Other information as recorded from the patients' record was:**

1. country of birth
2. periodontal status as assessed by dental officers in A & D at Westmead Centre Dental Clinical School
3. if patients were not examined, the reason was recorded under 'reasons not seen'.

**WHO (1977) index:**

The recording boxes for periodontal status and periodontal treatment requirements were reproduced from the WHO combined oral health and treatment assessment form.
CPITN index:

Boxes for recording this index followed the guidelines suggested by Ainamo et al (1982). There were also 28 tooth boxes (which excluding the 3rd molars) with each subdivided for buccal and lingual recordings. Each buccal and lingual surface had 2 scores (mesial and distal) recorded.

Boxes were also available for:

1. recording 2 and 4 teeth duplicates
2. recording CPITN periodontal status
3. recording CPITN treatment requirements

Criteria for recording periodontal status and treatment needs were stated on the form.
9.2 SUBJECTS AGED 15 AND OVER AT ASSESSMENT & DIAGNOSIS DEPARTMENT
WESTMEAD CENTRE DENTAL CLINICAL SCHOOL

9.2.1 Sample

The Dental Clinical School at Westmead serves the Western Metropolitan Health Region which had a population of 1,300,000 on the 30th June, 1983. The number of persons eligible for free treatment at public dental facilities was 528, 467 (41%) (Sheen 1984). Patients eligible for treatment include:

1. the unemployed
2. those on sickness benefit
3. all school children under 18
4. pensioners (which include old age pensioners, invalid pensioners and single parents)
5. newly arrived migrants who have been residing in Australia for less than 6 months.

The initial intention was to examine an expected sample of 400 patients during the 3 week period from 14th May to 1st June, 1984. But due to a relatively low number of patients passing through Assessment and Diagnosis (30-40/day) and the high proportion of children, the study period was extended to 4 weeks from the 14th May to 8th June, 1984. The survey was stopped on 7th June when a sample size of 200 patients 15 years and over was reached.

9.2.2 Examination Procedures

Location:

Permission was obtained from the Director of Assessment and Diagnosis to use Surgery 1 in the Assessment and Diagnosis Department for the initial 3 week study period. Surgery 2 was used for the last week of the study. The survey was conducted from 9 am to 5 pm with a lunch break from 12.30 to 1.30 pm.
The Dental Officers working at A & D were requested to send all patients aged 15 and over with their records after they had completed a general assessment (including medical history) and treatment plan. The writer did not examine patients who were fully edentulous, those who had a medical history which contra-indicated probing without antibiotic cover, and certain groups of patients who were required to have a Hepatitis-B test prior to treatment.

**Instruments and equipment:**

Instruments used were WHO 621 periodontal probes (Figure 1) and standard plane mouth mirrors.

There were sufficient sterilised mouth mirrors and periodontal probes to last each session. Disposable gloves were used for examining every patient. Tweezers, pledgets of cotton and Spravit were used when necessary.

Clinical examinations were carried out with the patient in a Siemens dental chair (model SL2/S). The surgeries had good natural and fluorescent lighting and a Siemens Sirolux dental overhead light was used.

**Recording:**

Graduate students from the DPH(Dent) and MDSc (Dental Public Health) courses kindly assisted by acting as recorders. The examiner read the patient's medical history and their records were passed on to recorders if there was no contra-indication to the use of the probe.
Recorders had survey forms on a clip-board and recorded:

1. name of examiner
2. date
3. country of birth
4. A & D assessment by dental officers

A patient identification label from the patient's file was placed on the form and the pre-assigned study number was written on.

Oral examination:
The dental chair and light was adjusted to suit the examiner with patient in a prone position. The examiner was seated at the head of the patient and the recorder to the left. The procedure was explained to the patient. The WHO (1977) index was first used followed by the CPITN Index.

9.2.3 The WHO (1977) Index

Method of assessment:
The method of assessment used was that suggested by WHO (1977). The mouth was divided into 6 segments: anterior, from canine to canine, and left and right posterior, from first premolar to the last tooth in the arch, for the mandible and maxilla.

Any missing sextant was called out and the appropriate box was crossed out by recorder in the form. Each assessment was made independently. Soft deposits were all noted before calculus was recorded. All recordings of calculus were made before those of intense gingivitis or advanced periodontal involvement. The presence or absence of each of
these four conditions was recorded for the right maxillary posterior segment then for the maxillary anterior segment and finally for the left maxillary posterior segment. The same sequence was followed for the mandible.

Time was noted by recorder just before starting, and at completion of assessment.

Criteria for assessment and coding:

Soft deposits:

Any soft deposit seen on one or more teeth within the segment gave a score of '1' for that segment. If no soft deposit was detected visually within a segment a score '0' given for that segment. The only instrument used was the mouth mirror.

Calculation:

A score of '1' was given for the segment if any tooth or teeth within the segment had calculus. When in doubt, the 621 probe was used to confirm if the deposit was indeed calcified.

Intense gingivitis:

A '1' score was given to a segment when the gingiva surrounding one or more teeth in that segment had one or more of the following conditions present:

1. One or more areas of the papillary or marginal gingiva showed marked changes in colour.
2. If digital palpation caused bleeding.
3. Loss of stippling and tone of the papilla.

A score '0' was given for a segment when:

1. There was no conspicuous change in colour.
2. There were only minor deviations in gingival colour.
3. There were only minor alterations in gingival forms.
4. There was no bleeding after digital palpation.
Advanced periodontal involvement:

Major diagnostic signs for recording advanced periodontal involvement were given a score "1" if there was:

1. Definite tooth mobility
2. Or if a periodontal pocket greater than 3 mm in depth was present accompanied by signs of one or more of the following conditions:
   (a) intense gingivitis (as above)
   (b) marked changes in gingival contour
   (c) suppuration
   (d) or advanced gingival recession with exposure of cementum

Intra-examiner duplicates:

A full duplicate recording was done by the examiner on every 10th patient.

Inter-examiner variation:

A total of 20 duplicate examinations were completed by the examiner's supervisor, Associate Professor P.D. Barnard. Time taken was noted for each examination.
9.2.4 The CPITN Index

Method of assessment:

The method used was to that described by Ainamo et al (1982).

Periodontal status scores were recorded for sextants. Third molars were not included, except when they were functioning in place of 2nd molars. Sextants contain the following teeth:

<table>
<thead>
<tr>
<th>17 - 14</th>
<th>13 - 23</th>
<th>24 - 27</th>
</tr>
</thead>
<tbody>
<tr>
<td>47 - 44</td>
<td>43 - 33</td>
<td>34 - 37</td>
</tr>
</tbody>
</table>

The probing procedure:

Each tooth was probed to determine:

1. pocket depth
2. detect calculus
3. bleeding response

The WHO 621 periodontal probe was used. Probing force was no more than 25G (probing force applied by examiner was tested during the preliminary study). Pain to the patient during probing was an indication of a too heavy probing force.

Since there was no rule specifying the number of separate probings to be made in the publication of Ainamo et al (1984), it was decided that each tooth was to have four separate probings recorded. The four probings were to be done in the mesial and distal inter-proximal area of the buccal and lingual surface of each tooth.

This decision was reached because:

1. From the review of literature, it was concluded that when individual surfaces of teeth are considered, the greatest incidence and severity of periodontal disease was found in the inter-proximal areas.

2. Mid-point probings were excluded, because Pritchard (1978) in his study found that exclusion of all mid-point measurements from a probing examination results in only one to two percent of patients not having their deepest crevice point detected.
Full mouth recording:

This recording was carried out on every second patient. Teeth examined were all fully erupted teeth excluding 3rd molars, except when they were functioning in place of 2nd molars. Time was noted for examination.

The examination commenced with the recording of all missing teeth or sextants in the sequence of upper right quadrant followed by upper left, then lower right and finally the lower left quadrant. Missing teeth or sextants were indicated by a diagonal line in the appropriate box.

The examination with the probe also followed this sequence of quadrants and the actual probing began at the distal surface of the last tooth in each quadrant proceeding along the buccal aspect until the mid line was reached. Then the buccal aspects of the upper left quadrant were examined. When the examination of the buccal aspect of upper left quadrant was completed the palatal aspect of upper left quadrant was examined followed by the upper right. All measurements were taken from the distal and mesial inter-proximal areas of each tooth. The examination procedure was the same for the mandible.

Partial mouth recording:

For every second patient a partial mouth recording was completed. Teeth examined were the 10 index teeth suggested by Ainamo et al (1982) which were:

<table>
<thead>
<tr>
<th>17</th>
<th>16</th>
<th>11</th>
<th>26</th>
<th>27</th>
</tr>
</thead>
<tbody>
<tr>
<td>47</td>
<td>46</td>
<td>31</td>
<td>36</td>
<td>37</td>
</tr>
</tbody>
</table>
When one of the designated molar teeth was absent, the one molar recording was done. If no index teeth were present in the sextant qualifying for examination, all remaining teeth in that sextant were examined. The sequence of examination and number of probings done for each tooth was similar to that described in the full mouth recording.

Criteria for scoring:

For assessing periodontal status of each area of the tooth probed the following scores were assigned:

Score 4  When the colour coded area of the probe completely disappeared into the pathologic pocket, the pocket depth was 6 mm or more.

Score 3  If colour coded area remained partly visible, pocket depth was either 4 or 5 mm.

Score 2  When there were no pocket depths exceeding 3 mm but supra- or sub-gingival calculus present, score 2 was assigned.

Score 1  If there were no pockets or calculus, but there was bleeding after probing, a score of 1 was assigned.

Score 0  No pockets, calculus or bleeding on probing were observed.

Ainamo et al (1982) suggested that bleeding could be delayed up till 30 seconds after probing. After all teeth in the quadrant were probed for pockets and calculus, the probed areas were again examined for inter-proximal bleeding and score 0 changed to 1 if appropriate.
Intra-examiner duplicate patients:

In every tenth patient (20 of 200) a replicate examination was carried out.

Intra-examiner duplicate teeth:

To further assess intra-examiner variation a 4 teeth duplicate examination was done on every second patient who had been examined using a full mouth recording (200 teeth). The recorder called out at random one tooth from each quadrant for re-measurement. The measurement was recorded in the box for duplicate examinations with the tooth identification.

A 2 teeth duplicate examination was done on every second patient who had been examined using the index teeth only (100 teeth). Recorders called out one tooth at random in each arch for these duplicates.

Inter-examiner variation:

To determine inter-examiner variation a total of 20 duplicate examinations each were done by the writer's supervisors, Associate Professor P.D. Barnard and Dr. J. Pritchard.
9.3 SUBJECTS AGED 6-14 AT ASSESSMENT & DIAGNOSIS DEPARTMENT
WESTMEAD CENTRE DENTAL CLINICAL SCHOOL

Samples of 20 children in each age group 6-9 and 10-14 were examined during the period 17th - 25th May, 1984.

Survey forms used and examination procedures were the same as that described for those aged 15 and over with the following exceptions:

1. no full mouth recording using the CPITN index was done. Only partial recording, using the 10 index teeth were used to assess periodontal status and treatment need.

2. No inter-examiner duplicates were done but intra-examiner duplicates were carried out on 1 in 10 patients and for 2 teeth in every 2nd patient.
9.4 FIRST YEAR DENTAL STUDENTS, UNIVERSITY OF SYDNEY

First year dental students of the University of Sydney were examined to assess their periodontal status and treatment needs. Examinations were carried out at the dental laboratory, in the Anderson Stuart Building, University of Sydney on 12th and 26th June, 1984.

Forty five of the students were examined by the writer and 45 by the writer's supervisor, Associate Professor P.D Barnard. Out of 90 students, only 40 were born in Australia. Ages for the group ranged from 17 to 28 with a mean age of 19.7 years.

Standard mouth mirrors, WHO 621 periodontal probes, rubber gloves and cold sterilization were used. Cold sterilization of the periodontal probes had to be carried out as there were not enough probes to last the entire examination session. There was good natural and fluorescent lighting in the laboratory and a bench light was used with students examined in an upright position seated in portable chairs.

Partial recordings of the CPITN index using 10 index teeth were done. No full mouth recording of the CPITN index was used.

A 2 teeth intra-examiner duplicate examination was done on every second patient and a replicate intra-examiner duplicate done on every tenth subject using the CPITN index. A full mouth intra-examiner duplicate was done on every tenth patient using the WHO (1977) index.
9.5 CLASSIFICATION OF PERIODONTAL TREATMENT NEEDS

9.5.1 WHO Assessment

The criteria for recording periodontal treatment needs was similar to that in the WHO Manual Oral Health Surveys - Basic Methods, 2nd ed (1977).

A code 0, 1, 2, 3, 4 or 5 was given accordingly.

Code 0  No treatment necessary. There were no obvious signs of soft deposits, calculus, intense gingivitis or advanced periodontal involvement.

Code 1  Oral hygiene instruction. Soft deposits were present in one or more segments but there were no obvious signs of either intense gingivitis or advanced periodontal involvement.

Code 2  Prophylaxis and oral hygiene instruction. Soft deposit and calculus were present. Intense gingivitis was recorded in one or more segments but there were no obvious signs of advanced periodontal involvement.

Code 3  Periodontal therapy without the extraction of any tooth for periodontal reasons. There were obvious signs of advanced periodontal involvement in one or more segments but the teeth were functionally satisfactory.

Code 4  Treatment which includes the extraction of one or more, but not all, teeth for periodontal reasons. There were obvious signs of advanced periodontal involvement in one or more segments and in one or more teeth the disease had proceeded to the terminal stage where these teeth were so loose and/or non-functional that conservative therapy was neither warranted nor possible.

Code 5  Full extraction. Advanced periodontal involvement had proceeded to a stage where all teeth (or all but a few teeth) were so loose and/or non-functional that conservative therapy was neither warranted nor possible.
9.5.2 CPITN Assessment

Sextant disease status scores were translated into treatment needs. A sextant was assigned a code for treatment need only if there were 2 or more teeth in that sextant, not requiring extraction. Any sextant with less than 2 functioning teeth was assigned as a missing sextant. A patient had their disease status classified to periodontal treatment need codes on a sextant basis as indicated below:

<table>
<thead>
<tr>
<th>Disease Status Score</th>
<th>Treatment Need Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Code 0 = no treatment required</td>
</tr>
<tr>
<td>1</td>
<td>Code I = improvement in personal oral hygiene</td>
</tr>
<tr>
<td>2 or 3</td>
<td>Code II = improvement in personal oral hygiene and scaling</td>
</tr>
<tr>
<td>4</td>
<td>Code III = improvement in personal oral hygiene &amp; scaling &amp; complex treatment</td>
</tr>
</tbody>
</table>

A recording of disease status score 0 for a sextant indicated there was no need for treatment and if score 1, the need for improvement in personal oral hygiene. A score 2 indicated the need for professional cleaning of the teeth. As moderate pocketing (4 or 5 mm, score 3) can likewise be managed with a combination of professional and personal cleaning of the teeth, the treatment need was the same for scores 2 and 3 and these patients also required oral hygiene instruction.

A sextant scoring code 4 may or may not be successful treated by means of deep scaling and efficient personal oral hygiene measures. Score 4 was therefore assigned to 'complex treatment' which may involve deep scaling and root planing under local anaesthesia. Surgical intervention may also be required. (Ainamo et al 1982).
9.6 Collation and Analysis of Data

9.6.1 Sample

Information collected during the period 14th May to 8th June, 1984 was summarised as follows:

(a) Daily and total number of patients that went through A & D
(b) Daily and total number of patients that were booked
(c) Daily and total number of patients that were unable to attend (UTA) or failed to attend (FTA)
(d) Number of patients that were fully edentulous
(e) Number of patients that were not examined for medical or other reasons
(f) Age distribution (number and percent) in 5 year age groups
(g) Distribution by country of birth of patients examined

9.6.2 CPITN Index: Periodontal Status

Periodontal status as assessed using the CPITN index was determined for the 3 study groups. The 200 patients examined in the 15 years and over group were put into the four different age groups, 15-19, 20-29, 30-44, 45-64, which were recommended by WHO (1978). The rest were grouped as 65 and above.

Children under 15 were grouped into 6-9 and 10-14 age groups.

All first year dental students were grouped together.

Periodontal status as derived from 10 index teeth was calculated for each age group and the following information was summarised:

1. Number of subjects in group (N)
2. Total number of sextants (N x 6)
3. Total number of sextants affected with the different disease status scores - 0, 1, 2, 3, 4 or X (which is a missing sextant).
4. Number of subjects with sextants affected with the different disease status scores.

5. Percent (%) of subjects with sextants affected with the different disease status scores.

\[
\text{Number of subjects affected} \times 100 \\
\text{Number of subjects in group (N)}
\]

6. Mean number of sextants affected per subject with the different disease status scores.

\[
\frac{\text{Total sextants affected}}{\text{Number of subjects in group (N)}}
\]

7. Mean number of sextants affected with the different disease status scores per subject affected.

\[
\frac{\text{Number of sextants affected}}{\text{Number of subjects with sextants affected}}
\]

8. Number of subjects by worst severity scores. This was obtained by noting the worst score in the mouth for each subject.

9. Percent (%) of subjects with worst severity score derived from 7.

9.6.3 CPITN Index: Treatment Needs

Treatment needs for the different groups were calculated in a similar manner to that described for periodontal status.

1. number of sextants with need
2. number of subjects with need
3. percent (%) of subjects with need
4. mean number of sextants with need
5. number of subjects by worst severity code
6. Percent (%) of subjects by worst severity code
9.6.4 CPITN Index: Periodontal Status and Treatment Needs

Variations in Assessment

Partial versus full mouth recording:
From the 100 subjects with full mouth recorded data, partial recording data were derived from it by taking out data for the 10 index teeth which were:

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<tbody>
<tr>
<td>17</td>
<td>16</td>
<td>11</td>
<td>26</td>
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<tr>
<td>27</td>
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<td></td>
<td>36</td>
</tr>
<tr>
<td>47</td>
<td>46</td>
<td>21</td>
<td>37</td>
</tr>
</tbody>
</table>

When both or one of the designated molar teeth were present, the worst disease status score from those tooth surfaces was recorded for the sextant. If none of the index teeth were present in a sextant qualifying for examination, the worst disease status score was obtained from the remaining teeth in that sextant. Periodontal status from partial and full mouth recordings were compared within age groups.

Four probings per tooth versus two probings per tooth:
The efficiency of 2 probings per tooth in detecting the various disease status score was compared to that of 4 probings/tooth using index teeth. Two combinations of 2 probings were tested.

1. The first combination of 2 probings tested were the mesial and distal buccal measurements of maxillary index teeth and mesial and distal lingual measurements of mandibular index teeth.

2. The second combination of two probings tested were the mesio-buccal and mesio-lingual measurements for all index teeth.

The 2 probing measurements were taken out from the original 4 probing recordings. The worst disease severity score from 4 probings/tooth was plotted against the worst disease severity score from 2 probings/tooth for each patient. The number and percent of identical score recordings were calculated.
Six index teeth versus ten index teeth for subjects under 20:

For age groups 10-14 and 15-19, and for the 18 year old dental students the data of the 10 index teeth recording was used to derive data for 6 index teeth (i.e. without 2nd molars). The periodontal status and treatment needs results with 6 index teeth recording were compared to 10 index teeth recording of periodontal status and treatment needs.

Six index teeth with mesial probing of first molar only:

For age groups 15-19, from the data of the 10 index teeth recording, data for 6 index teeth (i.e. without 2nd molars) with mesial probing only of 1st molar teeth was derived. The resultant periodontal status and treatment needs were compared to periodontal status and treatment needs with mesial and distal probings of 1st molars using 6 index teeth and to 4 probings of 10 index teeth.

9.6.5 WHO (1977) Index: Periodontal Status and Treatment Needs

Periodontal status:

The number and percentage of subjects affected with each of the periodontal disease status categories were calculated for all age groups. The mean number of segments involved per subject were also calculated.

Treatment needs:

The number and percentage of subjects requiring each of the various categories of periodontal treatment were calculated for all age groups.
9.6.6 **CPITN Index versus WHO (1977) Index Assessment**

For each of the 200 subjects examined, the WHO (1977) treatment needs code was plotted against the worst severity CPITN disease status score in the mouth. The WHO (1977) treatment needs code was also plotted against CPITN worst severity disease status score in the mouth, for subjects under 15 years and for the dental students.

9.6.7 **Clinical Examination Times**

Mean time, standard deviation (SD) and standard error (SE) was calculated for the clinical times taken for partial or full mouth recording using the CPITN index and the WHO (1977) index for subjects examined for each of the examiners.

9.6.8 **Duplicate Examination**

**CPITN index: Intra-examiner variation:**

To assess intra-examiner variation on a patient basis, the original worst disease severity score for each patient was plotted against the duplicate worst disease severity score for that patient. The number of persons affected for each disease status scores were compared and the percent of identical score recordings calculated.

This method of plotting original scores against their duplicate scores was also done for individual sextants and individual teeth to assess intra-examiner variation based on a sextant and tooth basis. The number of sextants and teeth affected for each disease status scores were compared and the percentage of identical disease scores recordings calculated.
**Inter-examiner variation:**

To assess inter-examiner variation on a patient basis, the worst disease severity score for each patient scored by the writer was plotted against the worst disease severity score as assessed by Dr. J. Pritchard. A similar method of plotting scores obtained by the writer on an individual sextant and individual tooth basis was used against the scores obtained by Dr. J. Pritchard.

The number of patients, sextants and teeth affected for each disease status score were compared (Chi-square) and the percentage of identical score recordings calculated.

Likewise inter-examiner variation on a patient, sextant and tooth basis was assessed between the writer and Associate Professor P.D. Barnard.

**WHO (1977) index: Intra-examiner variation:**

The number of sextants affected, mean number of sextants and percent of patients with a positive score were calculated and compared for original and duplicate examinations.

**WHO (1977) index: Inter-examiner variation:**

Likewise the number of sextants affected, mean number of sextants and percent of patients with a positive score for the writer and Associate Professor P.D Barnard were calculated and compared to assess inter-examiner variations.
10. RESULTS

10.1 SAMPLE

During the four week period 14th May to 8th June, 1984:

1. A total of 629 patients presented for Assessment & Diagnosis at the Westmead Centre Dental Clinical School.

2. With 2 dentists rostered, an average of 40 patients had been booked for each day. A daily summary of patients going through Assessment & Diagnosis is presented in Appendix 1.

3. Of the total 787 patients booked for that period, 158 (i.e. 20%) either failed to attend (FTA) or were unable to attend (UTA).

4. The age distribution of patients, in 5 year age groups, that went through Assessment & Diagnosis for the period 14th May to 8th June is shown in Table 1. Some 49% of the patients were under the age of 15 whereas only 6% of the patients were above the age of 60 years.

5. Table 2 presents a listing by country of birth of patients examined 15 years of age and over. Fifty five percent of the 200 patients examined were born in Australia. Indo-chinese are under-represented as all except one still required routine screening for Hepatitis-B.

6. Of the patients over 15 presenting for Assessment & Diagnosis the following were not examined:

   19 for medical reasons
   32 were fully edentulous
   69 not examined for other reasons
   (examiner away or samples completed)
Table 1  Age distribution of patients at
Assessment & Diagnosis Department.

14th May - 8th June, 1984

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Examined CPTN No.</th>
<th>Examined %</th>
<th>Not Examined No.</th>
<th>Not Examined %</th>
<th>Total No.</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 6</td>
<td>0</td>
<td>11.8</td>
<td>46</td>
<td></td>
<td>46</td>
<td>7.3</td>
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<tr>
<td>6 - 9</td>
<td>20</td>
<td>8.3</td>
<td>90</td>
<td>23.1</td>
<td>110</td>
<td>17.5</td>
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<tr>
<td>10 - 14</td>
<td>20</td>
<td>8.3</td>
<td>134</td>
<td>34.4</td>
<td>154</td>
<td>24.5</td>
</tr>
<tr>
<td>15 - 19</td>
<td>43</td>
<td>17.9</td>
<td>17</td>
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<td>9.5</td>
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<tr>
<td>20 - 24</td>
<td>23</td>
<td>9.6</td>
<td>11</td>
<td>2.8</td>
<td>34</td>
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<tr>
<td>25 - 29</td>
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<td>30 - 34</td>
<td>23</td>
<td>9.6</td>
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<tr>
<td>Total</td>
<td>240</td>
<td>100%</td>
<td>389</td>
<td>100%</td>
<td>629</td>
<td>100%</td>
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</tbody>
</table>
Table 2  Country of birth of subjects examined at Assessment & Diagnosis Department.
15 years and over

<table>
<thead>
<tr>
<th>Country</th>
<th>Number</th>
<th>Total Australia</th>
<th>Total Europe</th>
<th>Total Asia</th>
<th>Total South America</th>
<th>Total Africa</th>
<th>Total Oceania</th>
<th>Total North America</th>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uruguay</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egypt</td>
<td>2</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>North Africa</td>
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<td>Mauritius</td>
<td>1</td>
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<td></td>
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<tr>
<td>New Zealand</td>
<td>4</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* a number of subjects were not examined as they required prior Hepatitis B testing
10.2 CPITN INDEX: PERIODONTAL STATUS

10.2.1 Subjects 15 years and over at Assessment & Diagnosis

Distribution of subjects by their worst severity score recorded is shown for the different age groups in Table 3. The proportion of subjects in the sample with no periodontal disease was 2%. In 3% of the sample, disease manifestation was confined to gingivitis only (i.e. subjects with a worst disease score of 1). Nine percent of the sample had calculus (worst disease score of 2). The proportion of subjects with moderate periodontitis (worst disease score of 3) was 71% and with advanced periodontitis (worst disease score of 4) was 15%.

Table 4 shows the percentage of subjects with one or more sextants affected by age. Due to the very small sample in the 65 and above age group (8 subjects only) and their high proportion of missing sextants, this group will be excluded from discussion of the results.

Fifty one percent of the sample had one or more sextants free of disease and 15% had one or more sextants with advanced periodontal disease. As the age increased, there was a progressive increase in the proportion of subjects with one or more sextants affected with the more severe forms of the disease. None of the subjects in the 15-19 age group had advanced periodontal disease and the highest proportion of subjects with one or more sextants affected with 'no disease' (84%) was also in this group. The highest prevalence for 'bleeding only' was again in the 15-19 year group with 67%, and for 'calculus' was the 20-29 year olds at 69%. The highest proportions of subjects with one or more sextants affected with pockets 4-5 mm, was the 30-44 age group.
PERIODONTAL STATUS: CPITN INDEX ASSESSMENT

Table 3  Percentage of subjects affected by worst mouth score 15 years and over. By age

<table>
<thead>
<tr>
<th>AGE (YEARS)</th>
<th>NO. OF SUBJECTS (N)</th>
<th>NO DISEASE (Code 0)</th>
<th>BLEEDING ONLY (Code 1)</th>
<th>CALCULUS (Code 2)</th>
<th>POCKETS 4-5 mm (Code 3)</th>
<th>POCKETS ≥ 6 mm (Code 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>43</td>
<td>2</td>
<td>14</td>
<td>23</td>
<td>61</td>
<td>0</td>
</tr>
<tr>
<td>20-29</td>
<td>46</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>83</td>
<td>13</td>
</tr>
<tr>
<td>30-44</td>
<td>69</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>77</td>
<td>20</td>
</tr>
<tr>
<td>45-64</td>
<td>34</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>65</td>
<td>29</td>
</tr>
<tr>
<td>65 &amp; above</td>
<td>8</td>
<td>13</td>
<td>0</td>
<td>38</td>
<td>38</td>
<td>13</td>
</tr>
<tr>
<td>TOTAL</td>
<td>200</td>
<td>2</td>
<td>3</td>
<td>9</td>
<td>71</td>
<td>15</td>
</tr>
</tbody>
</table>
PERIODONTAL STATUS: CPITN INDEX ASSESSMENT

Table 4  Percentage of subjects with one or more sextants affected 15 years and over. By age

<table>
<thead>
<tr>
<th>AGE (YEARS)</th>
<th>NO. OF SUBJECTS (N)</th>
<th>NO DISEASE (Code 0)</th>
<th>BLEEDING ONLY (Code 1)</th>
<th>CALCULUS (Code 2)</th>
<th>POCKETS 4-5 mm (Code 3)</th>
<th>POCKETS &gt;6 mm (Code 4)</th>
<th>MISSING SEXTANT (Code X)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>43</td>
<td>84</td>
<td>67</td>
<td>49</td>
<td>65</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20-29</td>
<td>46</td>
<td>54</td>
<td>37</td>
<td>69</td>
<td>91</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>30-44</td>
<td>69</td>
<td>32</td>
<td>29</td>
<td>56</td>
<td>97</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>45-64</td>
<td>34</td>
<td>41</td>
<td>18</td>
<td>56</td>
<td>82</td>
<td>26</td>
<td>47</td>
</tr>
<tr>
<td>65 &amp; above</td>
<td>8</td>
<td>50</td>
<td>13</td>
<td>75</td>
<td>38</td>
<td>13</td>
<td>75</td>
</tr>
<tr>
<td>TOTAL</td>
<td>200</td>
<td>51</td>
<td>36</td>
<td>58</td>
<td>84</td>
<td>15</td>
<td>16</td>
</tr>
</tbody>
</table>
(97%) and with pockets 6 mm or more was the 45-64 age group (26%). Evidence of advanced periodontal disease was seen in 11% of the 20-29 year olds and this increased with age (30-44 - 17%, 45-64 - 26%). The highest proportion of subjects with one or more missing sextants (75%) was in the 65 and above age group.

Table 5 shows the mean number of sextants affected/subject by age. The mean number of sextants/subject for the sample were no disease 1.1; bleeding only 0.5; calculus 1.0; pockets 4-5 mm 2.6; pockets 6 mm or more 0.3; and missing sextants 0.5. By age, the mean number of sextants affected/subject also showed that the younger age group had the higher mean scores for no disease, bleeding and calculus, and the older age groups had higher mean scores for pockets 4-5 mm and pockets 6 mm or more. (Note: 65 and above age group excluded).

For those individuals for whom a positive score was recorded in one or more sextant, the mean number of sextants affected/subject affected is shown in Table 6. It appears the 15-19 year olds have a greater number of sextants affected with a lower score: no disease 2.9; bleeding 1.8. Apart from this observation there were minimal differences shown by age for the various disease status scores. The average number of sextants affected in each disease status category for all ages was about 2 except for the 3.1 sextants with pockets 4-5 mm per subject affected. The mean number of sextants affected/subject affected were: no disease 2.2; bleeding only 1.6; calculus 1.7; and pockets 6 mm or more 1.9.
Table 5  Mean number of sextants affected per subject 15 years and over. By age

<table>
<thead>
<tr>
<th>AGE (YEARS)</th>
<th>No. OF SUBJECTS (N)</th>
<th>NO DISEASE (Code 0)</th>
<th>BLEEDING ONLY (Code 1)</th>
<th>CALCULUS (Code 2)</th>
<th>POCKETS 4-5 mm (Code 3)</th>
<th>POCKETS ≥6 mm (Code 4)</th>
<th>MISSING SEXTANT (Code X)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>43</td>
<td>2.4</td>
<td>1.2</td>
<td>0.6</td>
<td>1.8</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>20-29</td>
<td>46</td>
<td>0.9</td>
<td>0.5</td>
<td>1.2</td>
<td>3.1</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>30-44</td>
<td>69</td>
<td>0.5</td>
<td>0.4</td>
<td>1.0</td>
<td>3.2</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>45-64</td>
<td>34</td>
<td>0.8</td>
<td>0.3</td>
<td>0.9</td>
<td>2.3</td>
<td>0.5</td>
<td>1.2</td>
</tr>
<tr>
<td>65 &amp; above</td>
<td>8</td>
<td>1.1</td>
<td>0.1</td>
<td>1.7</td>
<td>0.8</td>
<td>0.1</td>
<td>2.2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>200</td>
<td>1.1</td>
<td>0.5</td>
<td>1.0</td>
<td>2.6</td>
<td>0.3</td>
<td>0.5</td>
</tr>
</tbody>
</table>
PERIODONTAL STATUS: CPITN INDEX ASSESSMENT

Table 6  Mean number of sextants affected per subject affected
15 years and over. By age

<table>
<thead>
<tr>
<th>AGE (YEARS)</th>
<th>No. of Subjects (N)</th>
<th>No Disease Only (Code 0)</th>
<th>Bleeding Only (Code 1)</th>
<th>Calculus (Code 2)</th>
<th>Pockets 4-5 mm (Code 3)</th>
<th>Pockets ≥6 mm (Code 4)</th>
<th>Missing Sextant (Code X)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>43</td>
<td>2.9</td>
<td>1.8</td>
<td>1.3</td>
<td>2.7</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>20-29</td>
<td>46</td>
<td>1.7</td>
<td>1.4</td>
<td>1.8</td>
<td>3.5</td>
<td>2.2</td>
<td>0.0</td>
</tr>
<tr>
<td>30-44</td>
<td>69</td>
<td>1.6</td>
<td>1.5</td>
<td>1.8</td>
<td>3.3</td>
<td>1.8</td>
<td>3.2</td>
</tr>
<tr>
<td>45-64</td>
<td>34</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>2.8</td>
<td>1.8</td>
<td>2.6</td>
</tr>
<tr>
<td>65 &amp; above</td>
<td>8</td>
<td>2.3</td>
<td>1.0</td>
<td>2.2</td>
<td>2.0</td>
<td>1.0</td>
<td>3.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>200</td>
<td>2.2</td>
<td>1.6</td>
<td>1.7</td>
<td>3.1</td>
<td>1.9</td>
<td>2.9</td>
</tr>
</tbody>
</table>
10.2.2 Subjects Under 15 Years at Assessment & Diagnosis

Table 7 shows the periodontal status of subjects aged 6-9 and 10-14 years. The 6-9 age group had more subjects free of disease and with bleeding only (25% and 40%) than the 10-14 age group (15% and 20%). The 10-14's had a higher proportion of subjects with calculus and moderate pocketing (15% and 50%) than the 6-9 age group (5% and 30%).

Differences in prevalence and severity as age increased were apparent between these age groups. The percentages of subjects with one or more sextants affected for the two age groups, 6-9 years and 10-14 years, were: no disease (100%, 100%); bleeding (60%, 65%); calculus (5%, 30%); and pockets 4-5 mm (30%, 50%).

There did not appear to be significant differences between the age groups for the mean number of sextants affected for bleeding although there was marked increased prevalence of calculus and moderate pocketing in the 10-14 age group.

No major differences in the mean number of sextants affected/subject affected were apparent between the two age groups, with the possible exception for bleeding which was 1.8 for the 6-9 year olds and 1.5 for the 10-14 year olds.

These indices also indicate that the prevalence and severity was less in the children under 15 than in those of the 15-19 age group.
### Table 7  
Periodontal status: CPITN assessment

Subjects under 15 years: 6-9 years/10-14 years

<table>
<thead>
<tr>
<th>No. OF SUBJECTS</th>
<th>NO DISEASE</th>
<th>BLEEDING</th>
<th>CALCULUS</th>
<th>POCKETS 4-5 mm</th>
<th>POCKETS ≥6 mm</th>
<th>MISSING SEXTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 20/20</td>
<td>(Score 0)</td>
<td>(Score 1)</td>
<td>(Score 2)</td>
<td>(Score 3)</td>
<td>(Score 4)</td>
<td>(Score X)</td>
</tr>
<tr>
<td>Number of subjects affected</td>
<td>20/20</td>
<td>12/13</td>
<td>1/6</td>
<td>6/0</td>
<td>0/5</td>
<td>0/0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>100/100</td>
<td>60/65</td>
<td>5/30</td>
<td>30/0</td>
<td>0/25</td>
<td>0/0</td>
</tr>
<tr>
<td>Number of sextants (120/120)</td>
<td>73/77</td>
<td>22/20</td>
<td>1/6</td>
<td>11/0</td>
<td>0/13</td>
<td>0/0</td>
</tr>
<tr>
<td>Mean number</td>
<td>3.6</td>
<td>1.1</td>
<td>0.1</td>
<td>0.6</td>
<td>0.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Mean number per subject affected</td>
<td>3.8</td>
<td>1.0</td>
<td>0.3</td>
<td>0.9</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Number of subjects by worst severity score</td>
<td>5/3</td>
<td>8/4</td>
<td>1/3</td>
<td>6/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>25/15</td>
<td>40/20</td>
<td>5/15</td>
<td>30/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
</tbody>
</table>
10.2.3 First Year Dental Students, University of Sydney

The periodontal status of first year dental students at the University of Sydney is seen in Table 8. The proportion of subjects by worst severity score was only 5% with no disease, but none had advanced periodontal disease. Four percent had bleeding only, 17% had calculus and 74% moderate periodontitis.

The percentage of subjects with one or more sextants free of disease was high at 88%. The mean number of sextants affected/subject was low for bleeding and calculus at 0.9 and 0.4 respectively. However, those individuals affected with score 3 (pockets 4-5 mm), had an average of 3.0 sextants affected which was similar to the 15 and above age group at Assessment & Diagnosis, Westmead Centre Dental Clinical School. When comparison was made to the 15-19 year olds who had only 6 index teeth measured, the dental student group (with 10 index teeth measured) had slightly more subjects free of periodontal disease, fewer with bleeding and calculus and, but slightly more with pockets 4-5 mm.

When compared to the 20-29 year olds seen at Assessment & Diagnosis, Westmead Centre Dental Clinical School, with a similar number of index teeth assessed, it was found that the prevalence and severity of periodontal disease in the students was much lower than in the 20-29 year olds who had 13% with advanced periodontal disease and 0% with no disease. The 20-29 year olds also had higher mean numbers of sextants in the moderate periodontal disease category than did the 1st year dental students.
**PERIODONTAL STATUS: CPITN INDEX ASSESSMENT**

**Table 8**  
Periodontal status: CPITN index assessment  
First year dental students, University of Sydney

<table>
<thead>
<tr>
<th>No. OF SUBJECTS</th>
<th>NO DISEASE (Score 0)</th>
<th>BLEEDING ONLY (Score 1)</th>
<th>CALCULUS (Score 2)</th>
<th>POCKETS 4-5 mm (Score 3)</th>
<th>POCKETS ≥6 mm (Score 4)</th>
<th>MISSING SEXTANT (Score X)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of subjects affected</td>
<td>79</td>
<td>41</td>
<td>38</td>
<td>67</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>88</td>
<td>45</td>
<td>42</td>
<td>74</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Number of sextants (540)</td>
<td>221</td>
<td>77</td>
<td>44</td>
<td>198</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean number</td>
<td>2.5</td>
<td>0.9</td>
<td>0.4</td>
<td>2.2</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Mean number per subject affected</td>
<td>2.8</td>
<td>1.9</td>
<td>1.2</td>
<td>3.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Number of subjects by worst severity score</td>
<td>4</td>
<td>4</td>
<td>15</td>
<td>67</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>5</td>
<td>4</td>
<td>17</td>
<td>74</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
10.3 CPITN INDEX: TREATMENT NEEDS

10.3.1 Subjects 15 Years and Over at Assessment & Diagnosis

The treatment needs for subjects in the sample were obtained by translating their periodontal status scores into treatment need codes (refer Method 9.5.2). Most results, are therefore presented in tables rather than text.

Table 9 presents the distribution of subjects by worst treatment needs, by age. Of the total sample, 1% did not require any treatment, 3% required oral hygiene instruction only (code I), 81% required oral hygiene instruction and scaling (code II), and 15% required complex treatment (code III). The percentage of subjects requiring complex treatment increased with age: 13% in the 20-29; 22% in the 30-44; and 29% in the 45-64 age groups (the small sample 65 & above was excluded). The 15-19 age group was the only one with subjects (14%) who required oral hygiene instruction only. Subjects in all other age groups required at least scaling (code II) and others required complex treatment (code III).

Table 10 presents the percentage of subjects with one or more sextants requiring treatment, by age. The highest percentage of subjects having one or more sextants requiring treatment (94%) was for oral hygiene instruction and scaling. Only 15% of the subjects had one or more sextants requiring complex treatment. The 30-44 age group, seems to be the group most in need of treatment with 100% having one or more sextants requiring oral hygiene instruction and scaling, and 22% requiring complex treatment.
Table 9 Percentage of subjects with treatment needs by worst mouth score
15 years and over. By age

<table>
<thead>
<tr>
<th>AGE (YEARS)</th>
<th>No. OF SUBJECTS</th>
<th>No TREATMENT REQUIRED</th>
<th>ORAL HYGIENE INSTRUCTION</th>
<th>ORAL HYGIENE INSTRUCTION + SCALING</th>
<th>ORAL HYGIENE INSTRUCTION + SCALING + COMPLEX TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N)</td>
<td>(Code 0)</td>
<td>(Code 1)</td>
<td>(Code 11)</td>
<td>(Code 111)</td>
</tr>
<tr>
<td>15-19</td>
<td>43</td>
<td>2</td>
<td>14</td>
<td>84</td>
<td>0</td>
</tr>
<tr>
<td>20-29</td>
<td>46</td>
<td>0</td>
<td>0</td>
<td>87</td>
<td>13</td>
</tr>
<tr>
<td>30-44</td>
<td>69</td>
<td>0</td>
<td>0</td>
<td>78</td>
<td>22</td>
</tr>
<tr>
<td>45-64</td>
<td>34</td>
<td>3</td>
<td>0</td>
<td>68</td>
<td>29</td>
</tr>
<tr>
<td>65 &amp; above</td>
<td>8</td>
<td>13</td>
<td>0</td>
<td>76</td>
<td>13</td>
</tr>
<tr>
<td>TOTAL</td>
<td>200</td>
<td>1</td>
<td>3</td>
<td>81</td>
<td>15</td>
</tr>
</tbody>
</table>
Table 10  Percentage of subjects with one or more sextants requiring treatment
15 years and over. By age

<table>
<thead>
<tr>
<th>AGE (YEARS)</th>
<th>NO. OF SUBJECTS (N)</th>
<th>NO TREATMENT REQUIRED (Code 0)</th>
<th>ORAL HYGIENE INSTRUCTION (Code 1)</th>
<th>ORAL HYGIENE INSTRUCTION + SCALING (Code 11)</th>
<th>ORAL HYGIENE INSTRUCTION + SCALING + COMPLEX TREATMENT (Code 111)</th>
<th>MISSING Sextants</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>43</td>
<td>84</td>
<td>67</td>
<td>81</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20-29</td>
<td>46</td>
<td>54</td>
<td>35</td>
<td>98</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>30-44</td>
<td>69</td>
<td>32</td>
<td>26</td>
<td>100</td>
<td>22</td>
<td>27</td>
</tr>
<tr>
<td>45-64</td>
<td>34</td>
<td>35</td>
<td>15</td>
<td>94</td>
<td>21</td>
<td>64</td>
</tr>
<tr>
<td>65 &amp; above</td>
<td>8</td>
<td>38</td>
<td>0</td>
<td>88</td>
<td>13</td>
<td>100</td>
</tr>
<tr>
<td>TOTAL</td>
<td>200</td>
<td>49</td>
<td>34</td>
<td>94</td>
<td>15</td>
<td>26</td>
</tr>
</tbody>
</table>
Table 11 presents the mean number of sextants with treatment need per subject, by age. A sextant was assigned a treatment need code only if 2 or more functioning teeth were present in the sextant (Ainamo et al 1982). If there were less than 2 functioning teeth, that sextant was taken as a missing sextant and the teeth in that sextant were included in the adjoining sextant for treatment need assessment. This accounts for the increase in missing sextants in Table 11 compared to Table 5.

The mean number of sextants with need/subject was highest for code II at 3.4, followed by code 0 at 1.1, code I at 0.5 and with code III the lowest at 0.2. By age, the 20-29 age group had the highest mean score of 4.3 sextants requiring oral hygiene instruction and scaling. The mean number of sextants not requiring any treatment was high at 2.4 for the 15-19 age group. There was no real increase in the mean number of sextants requiring complex treatment with age: 0.2 for the 20-29; 0.3 for 30-44; and 0.3 for the 45-64, probably because of the greater number of sextants with missing and non-functioning teeth as age increased.
PERIODONTAL TREATMENT NEEDS: CPITN INDEX ASSESSMENT

Table 11
Mean number of sextants with treatment needs per subject
15 years and over. By age

<table>
<thead>
<tr>
<th>AGE (YEARS)</th>
<th>No. OF SUBJECTS</th>
<th>NO TREATMENT REQUIRED</th>
<th>ORAL HYGIENE INSTRUCTION</th>
<th>ORAL HYGIENE INSTRUCTION + SCALING</th>
<th>ORAL HYGIENE INSTRUCTION + COMPLEX TREATMENT</th>
<th>MISSING SEXTANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N)</td>
<td>(Code 0)</td>
<td>(Code 1)</td>
<td>(Code 11)</td>
<td>(Code 111)</td>
<td></td>
</tr>
<tr>
<td>15-19</td>
<td>43</td>
<td>2.4</td>
<td>1.2</td>
<td>2.4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>20-29</td>
<td>46</td>
<td>0.9</td>
<td>0.5</td>
<td>4.3</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>30-44</td>
<td>69</td>
<td>0.5</td>
<td>0.4</td>
<td>3.9</td>
<td>0.3</td>
<td>0.9</td>
</tr>
<tr>
<td>45-64</td>
<td>34</td>
<td>0.7</td>
<td>0.2</td>
<td>3.0</td>
<td>0.3</td>
<td>1.8</td>
</tr>
<tr>
<td>65 &amp; above</td>
<td>8</td>
<td>0.9</td>
<td>0.0</td>
<td>2.1</td>
<td>0.1</td>
<td>2.9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>200</td>
<td>1.1</td>
<td>0.5</td>
<td>3.4</td>
<td>0.2</td>
<td>0.8</td>
</tr>
</tbody>
</table>
10.3.2 Subjects Under 15 Years at Assessment & Diagnosis

Table 12 presents the treatment needs of subjects aged 6-9 and 10-14 years. The 6-9 age group had more subjects not requiring any treatment, and requiring oral hygiene instruction only (20% and 40%). The 10-14 year olds had a higher proportion of subjects requiring scaling (65%) when compared to the 6-9 age group (35%).

The percentage of subjects with one or more sextants requiring treatment for the 6-9 and the 10-14 age groups were similar (100%) for those not requiring any treatment and almost similar (60% and 65%) for those requiring oral hygiene instruction. More subjects required scaling in the 10-14 age group (65%) than in the 6-9 age group (35%). Similarly, there were no marked differences in the mean number of sextants requiring treatment for code 0 and code I but a difference for code II which was 0.6 for the 6-9 group and 1.2 for the 10-14 year olds.
PERIODONTAL TREATMENT NEEDS: CPITN INDEX ASSESSMENT

Table 12  
Treatment needs: CPITN index assessment  
Subjects under 15 years: 6-9 years/10-14 years

<table>
<thead>
<tr>
<th>No. OF SUBJECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$N = 20$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>NO TREATMENT REQUIRED (Code 0)</th>
<th>ORAL HYGIENE INSTRUCTION (Code 1)</th>
<th>ORAL HYGIENE INSTRUCTION + SCALING (Code 11)</th>
<th>ORAL HYGIENE INSTRUCTION + COMPLEX TREATMENT (Code 111)</th>
<th>MISSING SEXTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of subjects</td>
<td>20</td>
<td>12</td>
<td>7</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>affected</td>
<td>20</td>
<td>13</td>
<td>13</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>% of subjects</td>
<td>100</td>
<td>60</td>
<td>35</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>65</td>
<td>65</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Number of sextants</td>
<td>73</td>
<td>22</td>
<td>12</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>77</td>
<td>20</td>
<td>23</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Mean number</td>
<td>3.6</td>
<td>1.1</td>
<td>0.6</td>
<td>0.0</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>3.8</td>
<td>1.0</td>
<td>1.2</td>
<td>0.0</td>
<td>0.7</td>
</tr>
<tr>
<td>Mean number per subject affected</td>
<td>3.7</td>
<td>1.8</td>
<td>1.7</td>
<td>-</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>3.8</td>
<td>1.5</td>
<td>1.8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Number of subjects</td>
<td>5</td>
<td>8</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>by worst severity score</td>
<td>3</td>
<td>4</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>25</td>
<td>40</td>
<td>35</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>20</td>
<td>65</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
10.3.3 First Year Dental Students, University of Sydney

The treatment needs of the first year dental students at the University of Sydney as assessed using the CPITN index is seen in Table 13.

Five percent did not require any treatment, 4% required oral hygiene instruction, and 91% required both oral hygiene instruction and scaling.

The proportions of subjects with one or more sextants not requiring any treatment (88%) and requiring oral hygiene instruction and scaling (91%) were high and 45% had one or more sextants requiring oral hygiene instruction only.

Similarly, the mean number of sextants per subject who did not require any treatment or who required oral hygiene instruction and scaling were high at 2.5 and 2.6 respectively. Those affected subjects who required oral hygiene instruction and scaling had an average of 3.0 sextants affected.
Table 13  Treatment needs: CPITN index assessment

First year dental students, University of Sydney

<table>
<thead>
<tr>
<th>No. of Subjects</th>
<th>No. treatment required (Code 0)</th>
<th>Oral hygiene instruction (Code 1)</th>
<th>Oral hygiene instruction + scaling (Code 11)</th>
<th>Oral hygiene instruction + scaling + complex treatment (Code 111)</th>
<th>Missing sextant</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of subjects affected</td>
<td>79</td>
<td>41</td>
<td>82</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>88</td>
<td>45</td>
<td>91</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Number of sextants (540)</td>
<td>221</td>
<td>77</td>
<td>242</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean number per subject affected</td>
<td>2.5</td>
<td>0.9</td>
<td>2.6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean number per subject affected</td>
<td>2.8</td>
<td>1.9</td>
<td>3.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Number of subjects by worst severity score</td>
<td>4</td>
<td>4</td>
<td>82</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>5</td>
<td>4</td>
<td>91</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
10.3.4 Assessment & Diagnosis by Dental Officers versus CPITN Index Assessment

Dental officers at Assessment and Diagnosis did not record periodontal status in 43% of the sample of subjects 15 years and above and 9% of the subjects were recorded by the dental officers as having no periodontal disease. Eleven percent had mild periodontal disease, 31% had moderate periodontal disease and 6% had severe periodontal disease.

The qualitative assessments made by dental officers were compared to the CPITN disease status scores (Table 14). Of the 17 subjects assessed by dental officers as having no disease, 16 had pockets 4-5 mm and one had calculus. Of the 23 subjects assessed as having mild periodontal disease, one had pockets 6 mm or more and 20 had pockets 4-5 mm. Out of the 61 subjects assessed as having moderate periodontal disease, 9 had pockets 6 mm or more. For the 12 subjects assessed as having severe periodontal disease, 6 had pockets 4-5 mm. For the group of 87 subjects for whom the dental officers did not make a recording of the periodontal status, 55 (63%) had pockets 4-5 mm and 15 (17%) had pockets 6 mm or more.
Table 14 Assessment & Diagnosis by dental officers versus CPITN index assessment.

Subjects 15 years and over

<table>
<thead>
<tr>
<th>A &amp; D Score</th>
<th>CPITN Score</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>0</td>
</tr>
<tr>
<td>Blank</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>No Disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Severe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPITN Total</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>
10.4 CPITN INDEX: VARIATION IN ASSESSMENT

10.4.1 Partial Mouth versus Full Mouth Recording

Both full mouth recording (i.e. assessment of all teeth) and partial mouth recording (i.e. assessment of the 10 index teeth only) detected 1% of the subjects as being free from periodontal disease (Table 15). Partial recording gave a very slight under-estimation of disease prevalence. Partial recording detected 11% of patients with advanced periodontal disease compared to 13% with full mouth recording and 79% with moderate periodontal disease compared to 80% with the full mouth recording. Within age groups, there were no significant variations noted between the full and partial assessments.

There were slightly more apparent variations between partial mouth and full mouth recording when the percentage of subjects with one or more sextants affected for each of the periodontal status categories were compared (Table 16). Generally, the percentage of persons with sextants showing calculus, moderate, and severe pocketing was less for the partial recordings. The trends for bleeding only, calculus and moderate pocketing were not consistent within the different age groups. The percentage of subjects with one or more sextant free of disease was different between partial recording (50%) and full mouth recording (34%).

Partial mouth recording appeared to be proportionally less effective in detecting the more severe forms of periodontal disease. The mean sextant score/subject for pocketing (4-5 mm) was 2.8 with partial recording compared to 3.2 with full recording (Table 17). The mean sextant scores for deep pocketing (6 mm or more) were 0.2 with partial
recording and 0.3 with full recording. Identical mean sextant scores/subject were obtained for bleeding on probing and calculus. This partial recording was less effective in detecting pockets for each of the age groups but with only minor differences within age groups for bleeding on probing and for calculus.

Table 18 presents the mean number of sextants affected per subject affected by age. Again there were identical scores obtained for bleeding and calculus at 1.5 and 1.7 respectively. Differences (not statistically significant) were noted for pockets 4-5 mm between partial and full mouth recording (3.1 vs 3.4 sextants affected per subject affected).
Table 15  Partial mouth versus full mouth recording  
Percentage of subjects affected by worst mouth score  
15 years and over. By age

<table>
<thead>
<tr>
<th>AGE (YEARS)</th>
<th>NO. OF SUBJECTS (N)</th>
<th>NO DISEASE (Code 0)</th>
<th>BLEEDING ONLY (Code 1)</th>
<th>CALCULUS (Code 2)</th>
<th>POCKETS 4-5 mm (Code 3)</th>
<th>POCKETS ≥ 6 mm (Code 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>20-29</td>
<td>28</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>30-44</td>
<td>33</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>45-64</td>
<td>16</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>≥ 65</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>79</td>
<td>11</td>
</tr>
</tbody>
</table>
Table 16  Partial mouth versus full mouth recording
Percentage of subjects with one or more sextants affected
15 years and over. By age

<table>
<thead>
<tr>
<th>AGE (YEARS)</th>
<th>NO. OF SUBJECTS (N)</th>
<th>NO DISEASE (Code 0)</th>
<th>BLEEDING ONLY (Code 1)</th>
<th>CALCULUS (Code 2)</th>
<th>POCKETS 4-5 mm (Code 3)</th>
<th>POCKETS ≥ 6 mm (Code 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>22</td>
<td>75</td>
<td>45</td>
<td>59</td>
<td>63</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-29</td>
<td>28</td>
<td>64</td>
<td>46</td>
<td>57</td>
<td>67</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-44</td>
<td>33</td>
<td>18</td>
<td>15</td>
<td>24</td>
<td>9</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-64</td>
<td>16</td>
<td>56</td>
<td>37</td>
<td>12</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65 &amp; above</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
<td>50</td>
<td>33</td>
<td>54</td>
<td>89</td>
<td>11</td>
</tr>
</tbody>
</table>
PERIODONTAL STATUS: CPITN INDEX ASSESSMENT

Table 17  Partial mouth versus full mouth recording
Mean number of sextants affected per subject
15 years and over. By age

<table>
<thead>
<tr>
<th>AGE (YEARS)</th>
<th>NO. OF SUBJECTS (N)</th>
<th>NO DISEASE (Code C)</th>
<th>BLEEDING ONLY (Code 1)</th>
<th>CALCULUS (Code 2)</th>
<th>POCKETS 4-5 mm (Code 3)</th>
<th>POCKETS ≥ 6 mm (Code 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>22</td>
<td>1.7</td>
<td>1.0</td>
<td>0.6</td>
<td>2.8</td>
<td>0.0</td>
</tr>
<tr>
<td>20-29</td>
<td>28</td>
<td>1.3</td>
<td>0.8</td>
<td>0.5</td>
<td>1.1</td>
<td>2.9</td>
</tr>
<tr>
<td>30-44</td>
<td>33</td>
<td>0.4</td>
<td>0.2</td>
<td>0.1</td>
<td>1.1</td>
<td>3.0</td>
</tr>
<tr>
<td>45-64</td>
<td>16</td>
<td>1.2</td>
<td>0.8</td>
<td>0.3</td>
<td>0.9</td>
<td>1.9</td>
</tr>
<tr>
<td>65 &amp; above</td>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
<td>1.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
<td>1.0</td>
<td>0.6</td>
<td>0.5</td>
<td>1.0</td>
<td>2.8</td>
</tr>
</tbody>
</table>
### Table 18 Partial versus full mouth recording

Mean number of sextants affected per subject affected 15 years and over. By age

<table>
<thead>
<tr>
<th>AGE (YEARS)</th>
<th>NO. OF SUBJECTS (N)</th>
<th>NO DISEASE (Code 0)</th>
<th>BLEEDING ONLY (Code 1)</th>
<th>CALCULUS (Code 2)</th>
<th>POCKETS 4-5 mm (Code 3)</th>
<th>POCKETS ≥ 6 mm (Code 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>22</td>
<td>2.1</td>
<td>1.5</td>
<td>1.3</td>
<td>3.0</td>
<td>0.0</td>
</tr>
<tr>
<td>20-29</td>
<td>28</td>
<td>2.0</td>
<td>1.5</td>
<td>1.9</td>
<td>3.3</td>
<td>2.5</td>
</tr>
<tr>
<td>30-44</td>
<td>33</td>
<td>2.0</td>
<td>1.5</td>
<td>2.0</td>
<td>3.2</td>
<td>1.7</td>
</tr>
<tr>
<td>45-64</td>
<td>16</td>
<td>2.1</td>
<td>1.5</td>
<td>1.8</td>
<td>2.6</td>
<td>2.3</td>
</tr>
<tr>
<td>65 &amp; above</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
<td>2.1</td>
<td>1.8</td>
<td>1.7</td>
<td>3.1</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Partial/Full
10.4.2 Four Probings per Tooth versus Two Probings per Tooth

The effectiveness of 2 probings per tooth was compared to that of 4 probings per tooth in 200 subjects. The first combination was the mesial and distal buccal probings for the maxillary index teeth and the mesial and distal lingual probings of the mandibular index teeth. This combination of 2 probings per tooth identified similarly 2 patients with no disease, 1 patient with gingivitis only, and 13 patients with calculus only as did the 4 probings per tooth (Table 19). The only differences found were for pocketing where 2 probings per tooth detected only 147 out of 155 patients with 4-5 mm pockets. The 2 probings per tooth under-estimated the severity by detecting 6 of these patients as having calculus only, one as having gingivitis and one as having no disease. For pockets 6 mm or more, 2 probings per tooth detected 22 out of the 29 patients. The other 7 patients were reported as having pockets 4-5 mm when only two probings were recorded. Overall there was 93% agreement.

This first combination of 2 probings per tooth was compared to the 4 probings per tooth on a tooth basis using the 10 index teeth. Results on a tooth basis from 158 subjects 20 years and over are shown on Table 20. When 4 probings per tooth for all maxillary molars were compared to the 2 probings per tooth there was 86% agreement. For the maxillary incisor, there was 82 percent agreement using 4 probings and 2 probings. Two probings per tooth for the mandibular molars gave the highest agreement at 91 percent. However, the least agreement at 67 percent was for the mandibular incisor. For the total 1580 index teeth, there was 86% agreement when 4 probings were compared to 2 probings.
Variation within each of the index teeth groupings can be seen in Appendices 2-6 when 4 probings scores were plotted individually against 2 probings scores.

The second combination of 2 probings per tooth were the mesio-buccal and mesio-lingual probings for all index teeth. This combination detected the same patients with no disease, gingivitis and calculus as did the 4 probings per tooth (Table 21). This 2 probings per tooth combination detected 150 out of 155 patients with pockets 4-5 mm. Three patients were identified as having calculus, one as having gingivitis only, and one as having no disease. The 2 probings per tooth detected 24 out of 29 patients with pockets 6 mm or more with the other 5 patients identified as having pockets 4-5 mm. Overall there was 95% agreement.
Table 19  Four probings per tooth versus two buccal probings or two lingual probings per tooth.

Index teeth - worst mouth score.

Subjects 15 years and over

<table>
<thead>
<tr>
<th>Original Score</th>
<th>4 Probe</th>
<th>SCORE - 2 Probing</th>
<th></th>
<th></th>
<th></th>
<th>4 Probe Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Probe</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 (100)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1 (100)</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td></td>
<td>13 (100)</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td></td>
<td>147</td>
<td>155 (933)</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td>22</td>
<td>29 (76)</td>
</tr>
</tbody>
</table>

2 Probe Total 0 3 2 19 154 22 200 (938)
## COMPARISON OF CPITN SCORES

Table 20

Four probings per tooth versus two buccal or two lingual probings per tooth
Index teeth - worst tooth score
Subjects 20 years and over \( (N = 158) \)

<table>
<thead>
<tr>
<th></th>
<th>NUMBER OF TEETH</th>
<th>AGREEMENT</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No. of Teeth</td>
<td>% of Teeth</td>
<td></td>
</tr>
<tr>
<td>Molars 17, 16, 26, 27</td>
<td>632</td>
<td>543</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Incisor 11</td>
<td>158</td>
<td>130</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Molars 37, 36, 46, 47</td>
<td>632</td>
<td>576</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>Incisor 31</td>
<td>158</td>
<td>107</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>10 Index Teeth</td>
<td>1580</td>
<td>1356</td>
<td>86%</td>
<td></td>
</tr>
</tbody>
</table>
**COMPARISON OF CPITN SCORES**

Table 21  
Four probings per tooth versus two mesial probings per tooth.  
Index teeth - worst mouth score.  
Subjects 15 years and over

<table>
<thead>
<tr>
<th>4 Probe Score</th>
<th>SCORE - 2 Probings</th>
<th>4 Probe Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Probe Total</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
10.4.3 Six Index Teeth versus 10 Index Teeth – Subjects 10-14 Years

Periodontal status assessed using 6 index teeth was compared with periodontal status assessed using 10 index teeth for the 10-14 age group.

On a worst mouth status score there was no difference (Table 22). The mean number of sextants affected with pockets 4-5 mm was 0.9 with 6 index teeth and 1.2 with 10 index teeth. The mean number of sextants with no disease was 3.8 with 6 index teeth and 3.5 with 10 index teeth.

The percentage of subjects with one or more sextants affected with pockets 4-5 mm increased from 50% with 6 index teeth to 60% with 10 index teeth (not significant). No differences were noted in the scoring of bleeding and calculus.

There were small differences in the mean number of sextants affected per subject affected between 6 index teeth and 10 index teeth for pockets 4-5 mm (1.7 vs 1.9) and for no disease (3.8 vs 3.5).

When 6 index teeth were used instead of 10 index teeth there were minor differences only in scoring of pockets 4-5 mm and those with no disease.
Table 22   Six index teeth versus ten index teeth
Subjects 10-14 years

<table>
<thead>
<tr>
<th>No. OF SUBJECTS</th>
<th>NO DISEASE (Score 0)</th>
<th>BLEEDING ONLY (Score 1)</th>
<th>CALCULUS (Score 2)</th>
<th>POCKETS 4-5 mm (Score 3)</th>
<th>POCKETS ≥6 mm (Score 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of subjects affected</td>
<td>20</td>
<td>13</td>
<td>6</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>100</td>
<td>65</td>
<td>30</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>Number of sextants (120)</td>
<td>77</td>
<td>20</td>
<td>6</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Mean number</td>
<td>3.8</td>
<td>1.0</td>
<td>0.3</td>
<td>0.9</td>
<td>0.0</td>
</tr>
<tr>
<td>Mean number per subject affected</td>
<td>3.8</td>
<td>1.5</td>
<td>1.0</td>
<td>1.7</td>
<td>-</td>
</tr>
<tr>
<td>Number of subjects by worst severity score</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>15</td>
<td>20</td>
<td>15</td>
<td>50</td>
<td>0</td>
</tr>
</tbody>
</table>
10.4.4 Six Index Teeth versus Ten Index Teeth - Subjects 15-19 Years

On a worst mouth status score assessed using 6 index teeth, 2% had no disease, 14% had bleeding only, 23% had calculus only and 61% had pockets 4-5 mm, compared to 2% with bleeding only and 98% with pockets 4-5 mm using 10 index teeth (Table 23).

When the mean number of sextants affected per subject were compared, the major significant differences were in the scoring of pockets 4-5 mm and with no disease. The mean number of sextants affected per subject affected with pockets 4-5 mm was 1.8 with 6 index teeth and 2.7 with 10 index teeth, and for no disease was 2.4 and 1.7 with 10 index teeth.

Again for the percentage of subjects with one or more sextants affected, significant differences were seen in scoring of pockets 4-5 mm and those with no disease. The percentage of subjects with one or more sextants affected with pockets 4-5 mm increased from 65% to 98% with 10 index teeth.

The difference for those with no disease was also shown in the mean number of sextants affected per subject affected.

For this age group, the only significant differences were in scoring of pockets 4-5 mm and no disease when 10 index teeth were used instead of six index teeth.
Table 23  Six index teeth versus ten index teeth

Subjects 15-19 years

<table>
<thead>
<tr>
<th>No. of Subjects</th>
<th>No Disease (Score 0)</th>
<th>Bleeding Only (Score 1)</th>
<th>Calculus (Score 2)</th>
<th>Pockets 4-5 mm (Score 3)</th>
<th>Pockets ≥ 6 mm (Score 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 43</td>
<td>36</td>
<td>29</td>
<td>21</td>
<td>28</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>28</td>
<td>17</td>
<td>42</td>
<td>0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>84</td>
<td>67</td>
<td>49</td>
<td>65</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>77</td>
<td>65</td>
<td>40</td>
<td>98</td>
<td>0</td>
</tr>
<tr>
<td>Number of sextants (258)</td>
<td>105</td>
<td>51</td>
<td>27</td>
<td>75</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>73</td>
<td>44</td>
<td>23</td>
<td>118</td>
<td>0</td>
</tr>
<tr>
<td>Mean number</td>
<td>2.4</td>
<td>1.2</td>
<td>0.6</td>
<td>1.8</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>1.7</td>
<td>1.0</td>
<td>0.5</td>
<td>2.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Mean number per subject affected</td>
<td>2.9</td>
<td>1.8</td>
<td>1.3</td>
<td>2.7</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2.2</td>
<td>1.6</td>
<td>1.4</td>
<td>2.8</td>
<td>-</td>
</tr>
<tr>
<td>Number of subjects by worst severity score</td>
<td>1</td>
<td>6</td>
<td>10</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>42</td>
<td>0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>2</td>
<td>14</td>
<td>23</td>
<td>61</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
10.4.4.1 Six index teeth versus six index teeth without distal probings of first molars - subjects 15-19 years

On a worst mouth score, there were minor differences in scoring of those with no disease, calculus and moderate pocketing when 6 index teeth were compared to 6 index teeth without distal probing of the first molars. There was no difference in scoring of calculus (Table 24).

When the mean number of sextants per subject affected were compared, major differences were in the scoring of no disease and pockets 4-5 mm. The mean number of affected sextants per subject with pockets 4-5 mm for 6 index teeth was 1.8 and 1.2 for 6 index teeth without distal probing of the first molar. Likewise, when the mean number of sextants affected per subject affected were compared, differences were seen in the scoring of pockets 4-5 mm; being 2.7 with 6 index teeth and 2.0 with 6 index teeth without distal probing of the first molar. Only very minor differences were noted for scoring of bleeding and calculus.
Table 24  Six index teeth versus six index teeth without distal probing of first molar

Subjects 15-19 years

<table>
<thead>
<tr>
<th>No. of Subjects N = 43</th>
<th>No. Disease (Score 0)</th>
<th>Bleeding Only (Score 1)</th>
<th>Calculus (Score 2)</th>
<th>Pockets 4-5 mm (Score 3)</th>
<th>Pockets ≥6 mm (Score 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of subjects affected</td>
<td>36/39</td>
<td>29/30</td>
<td>21/21</td>
<td>28/25</td>
<td>0/0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>84/90</td>
<td>67/70</td>
<td>49/48</td>
<td>65/58</td>
<td>0/0</td>
</tr>
<tr>
<td>Number of sextants (25B)</td>
<td>105/125</td>
<td>51/55</td>
<td>27/28</td>
<td>75/50</td>
<td>0/0</td>
</tr>
<tr>
<td>Mean number</td>
<td>2.4/2.9</td>
<td>1.2/1.3</td>
<td>0.6/0.6</td>
<td>1.8/1.2</td>
<td>0.0/0.0</td>
</tr>
<tr>
<td>Mean number per subject affected</td>
<td>2.9/3.2</td>
<td>1.8/1.8</td>
<td>1.3/1.3</td>
<td>2.7/2.0</td>
<td>-/ -</td>
</tr>
<tr>
<td>Number of subjects by worst severity score</td>
<td>1/4</td>
<td>6/6</td>
<td>10/8</td>
<td>26/25</td>
<td>0/0</td>
</tr>
<tr>
<td>% of subjects</td>
<td>2/9</td>
<td>14/14</td>
<td>23/19</td>
<td>61/58</td>
<td>0/0</td>
</tr>
</tbody>
</table>
10.4.5 Six Index Teeth versus 10 Index Teeth - First Year Dental Students, University of Sydney

On a worst mouth status score, there were minor differences for scoring of no disease, bleeding and calculus and a major difference in the scoring of pockets 4-5 mm; with 55% having pockets 4-5 mm with 6 index teeth and 70% with pockets 4-5 mm with 10 index teeth (Table 25).

Similar patterns were also seen for the mean number of sextants affected per subject and percentage of persons with one or more sextants affected. The mean number of sextants affected with pockets 4-5 mm per subject was 1.4 with 6 index teeth and 1.9 with 10 index teeth.

However, for the mean number of sextants affected per subject affected, there was no difference for the scoring of pockets 4-5 mm which was 2.7 using either 10 or 6 index teeth. The major difference was in no disease which was 3.7 with 6 index teeth and 3.2 with 10 index teeth.
### Table 25

Six index teeth versus ten index teeth

First year dental students, University of Sydney

Subjects 18 years

<table>
<thead>
<tr>
<th>6 teeth/10 teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No. IN GROUP</strong></td>
</tr>
<tr>
<td><strong>N = 33</strong></td>
</tr>
<tr>
<td><strong>DISEASE</strong></td>
</tr>
<tr>
<td>Score 0</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Number of subjects affected</td>
</tr>
<tr>
<td>% of subjects</td>
</tr>
<tr>
<td>Number of sextants</td>
</tr>
<tr>
<td>Mean number</td>
</tr>
<tr>
<td>Mean number per subject affected</td>
</tr>
<tr>
<td>Number of subjects by worst severity score</td>
</tr>
<tr>
<td>% of subjects</td>
</tr>
</tbody>
</table>
10.5 WHO (1977) INDEX: PERIODONTAL STATUS

10.5.1 Subjects 15 Years and Over at Assessment & Diagnosis

Of the total sample of 200, 91% had soft deposits, 87% had calculus, 38% had intense gingivitis and 30% had advanced periodontal involvement (Table 26). The mean number of segments with soft deposits was 3.7, with calculus was 2.4, intense gingivitis 0.8 and advanced periodontal involvement 0.9 per subject. Thus, the highest percentage of subjects affected and the highest mean number of segments involved were for soft deposits, followed by calculus, with less involvement of intense gingivitis and advanced periodontal involvement.

The percentage of subjects and the mean number of segments involved with advanced periodontal involvement increased with age. Only 2% had advanced periodontal involvement in the 15-19 age group and this increased to 11% for the 20-29 group, 39% for 30-44, 59% for 45-64 and 87% for the 65 and above.

The mean number of segments involved with advanced periodontal involvement for the 15-19 year age group was 0.02 and for the 65 and above was 1.6.

10.5.2 Subjects Under 15 Years at Assessment & Diagnosis

The percentage of the subjects 6-14 years who had soft deposits was 88%, 28% had calculus and 5% had intense gingivitis (Table 26). The mean number of segments involved with soft deposits was 2.6, with calculus was 0.4 and with intense gingivitis was 0.1. None of the subjects in the 10-14 age group had intense gingivitis which was
Table 26  WHO (1977) index: periodontal status

Subjects 6 years and over

By age

<table>
<thead>
<tr>
<th>AGE YEARS</th>
<th>N</th>
<th>SOFT DEPOSIT</th>
<th>CALCULUS</th>
<th>INTENSE GINGIVITIS</th>
<th>ADVANCED PERIODONTAL INVOLVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>(\bar{x})</td>
<td>2</td>
<td>(\bar{x})</td>
</tr>
<tr>
<td>6-9</td>
<td>20</td>
<td></td>
<td>90</td>
<td>2.9</td>
<td>10</td>
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<tr>
<td>10-14</td>
<td>20</td>
<td></td>
<td>85</td>
<td>2.4</td>
<td>45</td>
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<td>40</td>
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<td>88</td>
<td>2.6</td>
<td>28</td>
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<td>15-19</td>
<td>43</td>
<td></td>
<td>86</td>
<td>2.7</td>
<td>67</td>
</tr>
<tr>
<td>20-29</td>
<td>46</td>
<td></td>
<td>96</td>
<td>4.2</td>
<td>96</td>
</tr>
<tr>
<td>30-44</td>
<td>69</td>
<td></td>
<td>94</td>
<td>4.0</td>
<td>88</td>
</tr>
<tr>
<td>45-64</td>
<td>34</td>
<td></td>
<td>88</td>
<td>3.2</td>
<td>94</td>
</tr>
<tr>
<td>65 &amp; above</td>
<td>8</td>
<td></td>
<td>66</td>
<td>1.8</td>
<td>87</td>
</tr>
<tr>
<td>TOTAL 15 years &amp; above</td>
<td>200</td>
<td></td>
<td>91</td>
<td>3.7</td>
<td>87</td>
</tr>
</tbody>
</table>
present in 10 percent of the 6-9 age group. For intense gingivitis
the mean number of segments involved was 0.1 for those 6-9. The 10-14
age group had more subjects with calculus (45%) when compared to the
6-9 age group (10%).

10.5.3 First Year Dental Students, University of Sydney
The percentage of dental students with soft deposits was 59%, calculus
49%, intense gingivitis 24% and with advanced periodontal involvement
3% (Table 27). The mean number of segments involved with soft
deposits was 1.6, with calculus was 0.7, intense gingivitis was 0.8
and advanced periodontal involvement was 0.1.
### Table 27: WHO (1977) index: periodontal status and treatment needs

First year dental students, University of Sydney

<table>
<thead>
<tr>
<th>Status</th>
<th>N</th>
<th>Subjects Affected</th>
<th>Segments Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number</td>
<td>%</td>
</tr>
<tr>
<td>Soft deposit</td>
<td>90</td>
<td>53</td>
<td>59</td>
</tr>
<tr>
<td>Calculus</td>
<td>90</td>
<td>44</td>
<td>49</td>
</tr>
<tr>
<td>Intense gingivitis</td>
<td>90</td>
<td>22</td>
<td>24</td>
</tr>
<tr>
<td>Advanced periodontal</td>
<td>90</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>involvement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No treatment</td>
<td>90</td>
<td>22</td>
<td>24</td>
</tr>
<tr>
<td>Oral health instruction</td>
<td>90</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Prophylaxis &amp; oral health</td>
<td>90</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td>instruction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Periodontal therapy - no</td>
<td>90</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>extraction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Periodontal therapy &amp;</td>
<td>90</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>extraction</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10.6 WHO (1977) INDEX: TREATMENT NEEDS

10.6.1 Subjects 15 Years and Over at Assessment & Diagnosis
The majority of subjects over 15 years of age required prophylaxis and oral health instruction (67%), followed by periodontal therapy (20%), oral health instruction 10% and only 1% required periodontal therapy with extractions of one or more, but not all teeth (Table 28). Two percent of the subjects did not require any treatment.

Within each age group, the majority of subjects required prophylaxis and oral health instruction, with the 20-29 age group being the group most in need (92%). None of the subjects in the 15-19 age group required any periodontal therapy. Only subjects in the 30-44 and 45-64 age groups required periodontal therapy and extraction of one or more teeth at 1% and 3% respectively. Subjects in the 45-64 and 30-44 age groups were those most in need of periodontal therapy (35% and 29% respectively).

10.6.2 Subjects Under 15 Years at Assessment & Diagnosis
Twelve percent of the subjects did not require any treatment, 60% required oral health instruction and 28% required prophylaxis and oral health instruction (Table 28).

By age, more subjects in the 6-9 age group required oral health instruction only (80%) compared to the 10-14 age group (40%). However, more subjects in the 10-14 age group required prophylaxis and oral health instruction (45%) compared to the 6-9 age group (10%).
Table 28 WHO (1977) index: periodontal treatment needs

Subjects 6 years and over

By age

<table>
<thead>
<tr>
<th>AGE YEARS</th>
<th>N</th>
<th>NO TREATMENT</th>
<th>ORAL HEALTH INSTRUCTION</th>
<th>PROPHYLAXIS &amp; ORAL HEALTH INSTRUCTION</th>
<th>PERIODONTAL THERAPY - NO EXTRACTION</th>
<th>PERIODONTAL THERAPY &amp; EXTRACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No. %</td>
<td>No. %</td>
<td>No. %</td>
<td>No. %</td>
<td>No. %</td>
</tr>
<tr>
<td>6-9</td>
<td>20</td>
<td>2</td>
<td>10</td>
<td>16</td>
<td>80</td>
<td>200</td>
</tr>
<tr>
<td>10-14</td>
<td>20</td>
<td>3</td>
<td>15</td>
<td>8</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>6-14</td>
<td>40</td>
<td>5</td>
<td>12</td>
<td>24</td>
<td>60</td>
<td>600</td>
</tr>
<tr>
<td>15-19</td>
<td>43</td>
<td>3</td>
<td>7</td>
<td>11</td>
<td>26</td>
<td>400</td>
</tr>
<tr>
<td>20-29</td>
<td>46</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>42</td>
<td>200</td>
</tr>
<tr>
<td>30-44</td>
<td>69</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>44</td>
<td>400</td>
</tr>
<tr>
<td>45-64</td>
<td>34</td>
<td>1</td>
<td>3</td>
<td>20</td>
<td>59</td>
<td>400</td>
</tr>
<tr>
<td>65 &amp; above</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>13</td>
<td>100</td>
</tr>
<tr>
<td>TOTAL</td>
<td>200</td>
<td>3</td>
<td>2</td>
<td>21</td>
<td>10</td>
<td>600</td>
</tr>
</tbody>
</table>

15 years & above
10.6.3 First Year Dental Students, University of Sydney

Sixty percent of subjects in this group aged 17-28 years required prophylaxis and oral health instruction, followed by those requiring oral health instruction only (15%) and only 1% required periodontal therapy. Twenty four percent of the subjects did not require any treatment (Table 27).
10.7 WHO (1977) INDEX TREATMENT NEEDS VERSUS CPITN INDEX

10.7.1 Subjects 15 Years and Over

The WHO (1977) index assessment result for each patient was plotted against their worst disease status score as assessed by the CPITN index (Table 29). Three of the subjects who were assessed as not requiring treatment by the WHO (1977) index, had pockets 4-5 mm when assessed by the CPITN index; nineteen out of the 21 patients assessed as requiring oral hygiene instruction only, had 4-5 mm pockets assessed by the CPITN index. One hundred and eleven out of the 134 subjects assessed as requiring prophylaxis and oral hygiene instruction actually had pockets 4-5 mm and 12 had pockets 6 mm or more. It is apparent that the WHO (1977) index under-estimated the severity of the disease.

Conversely, the WHO (1977) index also over-estimated the severity of disease. Out of the 40 subjects assessed as requiring periodontal therapy, 22 had pockets 4-5 mm and two of the patients had calculus only when assessed by the CPITN index.

10.7.2 Subjects Under 15 Years

Out of the 5 subjects assessed as not requiring any treatment by the WHO (1977) index, 2 had pockets 4-5 mm and 1 had gingivitis (Table 30). Out of the 24 patients assessed as requiring oral health education only, 9 had pockets 4-5 mm, 1 had calculus and 5 did not show any signs of disease as assessed by the CPITN index using 6 index teeth. Out of the 11 who were assessed as requiring oral health education and prophylaxis, 7 had pockets 4-5 mm. It was evident that the WHO (1977) index under-estimated the severity of the disease.
Table 29  WHO (1977) index: treatment needs versus CPITN index.

Subjects 15 years and over

<table>
<thead>
<tr>
<th>WHO Treatment</th>
<th>CPITN Score</th>
<th>Bleeding</th>
<th>Calculus</th>
<th>4-5 mm</th>
<th>≥ 6 mm</th>
<th>WHO Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proph. + OHI</td>
<td>1</td>
<td>10</td>
<td>111</td>
<td>12</td>
<td>134</td>
<td></td>
</tr>
<tr>
<td>Therapy No Exo</td>
<td>2</td>
<td>22</td>
<td>16</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Therapy Exo</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPITN Total</td>
<td>2</td>
<td>13</td>
<td>155</td>
<td>30</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>
Table 30  
WHO (1977) index: treatment needs versus CPITN index.

Subjects under 15 years

<table>
<thead>
<tr>
<th>WHO Treatment</th>
<th>CPITN Score</th>
<th>X</th>
<th>0</th>
<th>Bleeding</th>
<th>Calculus</th>
<th>4-5 mm</th>
<th>≥ 6 mm</th>
<th>WHO Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>OHI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>9</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Proph. + OHI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Therapy No Exo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Therapy Exo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPITN Total</td>
<td></td>
<td>8</td>
<td>11</td>
<td>3</td>
<td>18</td>
<td>0</td>
<td></td>
<td>40</td>
</tr>
</tbody>
</table>
10.7.3 First Year Dental Students, University of Sydney

Out of the 22 subjects assessed as requiring no treatment by the WHO (1977) index, 17 had pockets 4-5 mm and only 3 did not show any signs of disease when assessed by the CPITN index (Table 31). Out of the 13 assessed as requiring oral hygiene instruction only, 8 had pockets 4-5 mm and 3 had calculus. Out of the 54 patients assessed as requiring prophylaxis and oral hygiene instruction, 41 (i.e. 76%) had 4-5 mm pockets. It was evident that the WHO (1977) index under-estimated the severity of the disease.
Table 31  WHO (1977) index: treatment needs versus CPITN index.

First year dental students, University of Sydney

(10 Index Teeth)

S. Siva, P.D. Barnard

<table>
<thead>
<tr>
<th>WHO Treatment</th>
<th>CPITN Score</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>WHO Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>OHI</td>
<td></td>
<td>2</td>
<td>3</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proph. + OHI</td>
<td></td>
<td>1</td>
<td>2</td>
<td>10</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Therapy No Exo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Therapy Exo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPITN Total</td>
<td>4</td>
<td>5</td>
<td>14</td>
<td>67</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
10.8 CLINICAL EXAMINATION TIMES

The mean clinical time in minutes taken for a full recording of the CPITN for subjects 15 and over was 5.5 ± 2.11 (Table 32). For a partial mouth recording of the index teeth for the CPITN, examination time (+SD) for the writer was 3.1 ± 0.99 minutes, for Dr. J. Pritchard, it was 2.8 ± 0.91 minutes, and for Associate Professor P.D. Barnard was 3.2 ± 1.20 minutes.

The mean time taken for recording 4 probings of each index teeth for children by the writer was 2.4 ± 0.95 minutes.

The times taken for duplicate examinations were slightly less at 5.0 ± 2.85 minutes for a full mouth recording and 2.6 ± 1.08 minutes for 10 index teeth in subjects 15 years and over. For children under 15 years, the time taken for duplicate examination of index teeth was 2.0 ± 0.0 minutes.

The clinical time taken by the writer to use the WHO (1977) index for subjects 15 years and over was 1.0 ± 0.36 minutes and for subjects 15 years and under was 0.9 ± 0.15 minutes. Time taken for the WHO index by Barnard was 1.4 ± 0.48 minutes for subjects 15 years and over.

Less time was taken by the writer to carry out duplicate examinations for subjects 15 years and over (0.8 ± 0.28 minutes) and for subjects 15 years and under (0.8 ± 0.24 minutes). The time taken to use the WHO 1977 index was less than that required for the CPITN index using index teeth and full mouth examination.
Table 32  Clinical examination times.

CPITN index and WHO (1977) index

<table>
<thead>
<tr>
<th>Index</th>
<th>Minutes - Mean ±SD (±SE)</th>
<th>S. Silva</th>
<th>P.D. Barnard</th>
<th>J. Pritchard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CPITN Adults &gt; 15 years</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All teeth N = 94</td>
<td>5.5</td>
<td>±2.11</td>
<td>±0.22</td>
<td></td>
</tr>
<tr>
<td>Index Teeth N = 92</td>
<td>3.1</td>
<td>±0.99</td>
<td>±0.10</td>
<td></td>
</tr>
<tr>
<td><strong>CPITN Children &lt; 15 years</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index Teeth N = 38</td>
<td>2.4</td>
<td>±0.95</td>
<td>±0.15</td>
<td></td>
</tr>
<tr>
<td><strong>Duplicates:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CPITN Adult</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Teeth N = 10</td>
<td>5.0</td>
<td>±2.85</td>
<td>±0.90</td>
<td></td>
</tr>
<tr>
<td>Index Teeth N = 10</td>
<td>2.6</td>
<td>±1.08</td>
<td>±0.34</td>
<td></td>
</tr>
<tr>
<td><strong>CPITN Children N = 4</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td>±0.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| WHO Index              |                          |         |              |              |
| Adults N = 190         | 1.0                      | ±0.36   | ±0.03        | 20.48 (±0.11) |
| Children N = 38        | 0.9                      | ±0.15   | ±0.02        |              |
| **Duplicates:**        |                          |         |              |              |
| Adults N = 12          | 0.8                      | ±0.28   | ±0.08        |              |
| Children N = 4         | 0.8                      | ±0.24   | ±0.12        |              |
10.9 DUPLICATE EXAMINATION

10.9.1 CPITN Index: Intra-examiner Variation

The original worst severity status score for each patient was plotted against their duplicate worst severity status score. A 100 percent agreement was obtained (Appendix 7).

Each original status score for each sextant was plotted against their corresponding duplicate status sextant score (Table 33). Out of the 10 patients who had a score of 0, all were assessed as score 0 on duplicate examination. Most variation was found in the scoring of pockets 4-5 mm (score 3). For 65 of the sextants which were scored as having pockets 4-5 mm, 62 were scored similarly in the duplicate examination, with 2 scored 1 and one given a score 0. Out of the 11 sextants scored as 1 (bleeding on probing), 2 were scored as having pockets 4-5 mm. Out of the 11 sextants originally scored as having calculus, 1 was scored as having pockets 4-5 mm at the duplicate examination. For the total 120 sextants scored, there was agreement for 112 sextants i.e. there was a 95% agreement.

On a 2 teeth and 4 teeth duplicate examination there was 89% agreement (Table 34). Most variation was in the scoring of pockets 4-5 mm and pockets 6 mm or more. Out of the 124 teeth scored as having pockets 4-5 mm or more, only 107 were scored similarly to the duplicate examination (86% agreement). Two were scored as having pockets 6 mm or more and the others were scored as having either calculus (2), bleeding on probing (8) and no disease (5). Out of the 7 that were scored as having pockets 6 mm or more, 2 were scored as having pockets
Table 33  Duplicate examination.
CPITN index: intra-examiner variation.
Total sextant scores

<table>
<thead>
<tr>
<th>Original Score</th>
<th>DUPLICATE SCORE</th>
<th>Original Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X 0 1 2 3 4</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>18</td>
<td>18 (100)</td>
</tr>
<tr>
<td>0</td>
<td>10</td>
<td>10 (100)</td>
</tr>
<tr>
<td>1</td>
<td>9 2</td>
<td>11 (100)</td>
</tr>
<tr>
<td>2</td>
<td>10 1</td>
<td>11 (100)</td>
</tr>
<tr>
<td>3</td>
<td>1 2 62</td>
<td>65 (95)</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>5 (100)</td>
</tr>
<tr>
<td>Duplicate Total</td>
<td>18 11 11 10 66 5</td>
<td>120 (95%)</td>
</tr>
</tbody>
</table>
Table 34  Duplicate examination.
CPITN index: intra-examiner variation.
2 or 4 teeth scores

<table>
<thead>
<tr>
<th>Original Score</th>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Original Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25 (100)</td>
</tr>
<tr>
<td>0</td>
<td>69</td>
<td>5</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>76 (91)</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>25</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>27 (93)</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>37</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>41 (90)</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>8</td>
<td>2</td>
<td>107</td>
<td>2</td>
<td></td>
<td>124 (86)</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Duplicate Total 25 80  31  39 121  4 300 (89%)
Table 35  Duplicate examination.

CPITN index: intra-examiner variation.

Total tooth scores

<table>
<thead>
<tr>
<th>Original Score</th>
<th>DUPLICATE SCORE</th>
<th>Original Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X 0 1 2 3 4</td>
<td>90 (100)</td>
</tr>
<tr>
<td>0</td>
<td>35 10 1 8</td>
<td>54 (65)</td>
</tr>
<tr>
<td>1</td>
<td>10 14 3</td>
<td>27 (52)</td>
</tr>
<tr>
<td>2</td>
<td>1 30 10</td>
<td>41 (73)</td>
</tr>
<tr>
<td>3</td>
<td>11 6 16 128</td>
<td>161 (80)</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>7 (71)</td>
</tr>
<tr>
<td>Duplicate Total</td>
<td>90 57 30 47 151</td>
<td>380 (79%)</td>
</tr>
</tbody>
</table>
4-5 mm on the duplicate examination (71% agreement). There was 90% agreement on the scoring of calculus, 91% for no disease and 93% agreement on the scoring of bleeding on probing.

For the 20 replicate subject examinations taken on an individual tooth basis, there was only 79% agreement (Table 35). Most variation was again noted in the scoring of pockets 4-5 mm and pockets 6 mm or more. Out of the 161 teeth scored as having pockets 4-5 mm only 128 were scored similarly on the duplicate examination, i.e. an 80% agreement; the remaining 33 teeth were scored less, including 11 at no disease. There was 71% agreement on the scoring of pockets 6 mm or more. However, out of the 41 teeth scored as having calculus 10 (24%) were scored as having pockets 4-5 mm on duplicate examination.

10.9.2 CPITN Index: Inter-examiner Variation

On a worst severity status score for each patient there was a 100% agreement between the writer and examiner Dr. J. Pritchard (Appendix 8).

On a sextant basis there was 89% agreement between the 2 examiners (Table 36). There was a random variation between the 2 examiners with neither of the examiners showing definite trends in under-scoring or over-scoring. The variations were also not statistically significant.

On a tooth basis (Table 37), it appeared that Pritchard scored less than the writer for some teeth. Major variation was in the scoring of pockets 4-5 mm where there was only 63% agreement.
Table 36  Duplicate examination.

CPITN index: inter-examiner variation.

Total sextant scores (Pritchard)

<table>
<thead>
<tr>
<th>Original Score</th>
<th>DUPLICATE SCORE - Pritchard</th>
<th>Original Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>0</td>
</tr>
<tr>
<td>X</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duplicate Total</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>
Table 37  Duplicate examination.

CPITN index: inter-examiner variation.

Total tooth scores (Pritchard)

<table>
<thead>
<tr>
<th>Original Score Silva</th>
<th>DUPLICATE SCORE - Pritchard</th>
<th>Original Total Silva</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>x</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duplicate Total Pritchard</td>
<td>42</td>
<td>16</td>
</tr>
</tbody>
</table>
Inter-examiner variations between the writer and Associate Professor P.D. Barnard were compared. On a worst severity status score, there was 75% agreement. The main differences were in scoring of pockets 4-5 mm, and of 16 of the patients scored as having pockets 4-5 mm only 12 were scored similarly by Professor Barnard; a 75% agreement (Table 38).

On a sextant basis there was only 61% agreement between the writer and Barnard (Table 39). Again the major disagreement was in the scoring of pockets 4-5 mm, where Barnard under-scored 30 out of the 45 sextants scored as having pockets 4-5 mm by the writer, only a 33% agreement.

On a tooth basis there was only 54% agreement between the writer and Barnard (Table 40). Again it was obvious that Barnard had scored less when compared to the writer. All 6 teeth that were scored as having pockets 6 mm or more by the writer were scored as having pockets 4-5 mm by Barnard. Out of the 58 that were scored as having pockets 4-5 mm only 12 teeth were scored similarly by Barnard. The remaining 46 teeth were scored by Barnard as having either calculus (19), bleeding on probing (10) or no disease (17).
Table 38  Duplicate examination.
CPITN index: inter-examiner variation.
Worst mouth scores (Barnard)

<table>
<thead>
<tr>
<th>Original Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Siva</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Barnard</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Original Total Siva</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Duplicate Score - Barnard</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(2 agreement)

<table>
<thead>
<tr>
<th>Original Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Siva</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Barnard</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Original Total Siva</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Duplicate Score - Barnard</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Original Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td><strong>Siva</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Barnard</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Original Total Siva</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Duplicate Score - Barnard</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Duplicate Total Barnard | 7 | 13 | 0 | 20 |

(75%)
Table 39  Duplicate examination.
CPITN index: inter-examiner variation.
Total sextant scores (Barnard)

<table>
<thead>
<tr>
<th>Original Score Siva</th>
<th>DUPLICATE SCORE - Barnard</th>
<th>Original Total Siva</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>0</td>
</tr>
<tr>
<td>X</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duplicate Total Barnard</td>
<td>12</td>
<td>38</td>
</tr>
</tbody>
</table>
Table 40  Duplicate examination.
CPITN index: inter-examiner variation.
Total tooth scores (Barnard)

(\% agreement)

<table>
<thead>
<tr>
<th>Original Score Siva</th>
<th>DUPLICATE SCORE - Barnard</th>
<th>Original Total Siva</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>0</td>
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<tr>
<td>X</td>
<td>53</td>
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<tr>
<td>0</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duplicate Total Barnard</td>
<td>53</td>
<td>60</td>
</tr>
</tbody>
</table>
10.9.3 WHO (1977) Index: Intra-examiner variation

There was 100% agreement on the number of subjects with soft deposits, calculus, intense gingivitis and advanced periodontal involvement assessed during the original and duplicate examinations of the writer (Table 41). However, there were differences in the number of segments affected and the mean number of segments affected, but these differences were not statistically significant. Most variations noted were in assessing soft deposits and calculus. The mean number of segments affected with soft deposits was $3.9 \pm 2.2$ compared to $4.3 \pm 2.1$ for the duplicate examination. The mean number of segments affected with calculus was $2.3 \pm 1.7$ compared to $2.5 \pm 1.6$ on the duplicate examination.

There was no variation in the original and duplicate assessment of treatment needs for this group of 20 patients.
<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>SUBJECTS AFFECTED</th>
<th>SEGMENTS AFFECTED</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number</td>
<td>%</td>
</tr>
<tr>
<td><strong>Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft deposit</td>
<td>20</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(15)</td>
<td></td>
</tr>
<tr>
<td>Calculus</td>
<td>20</td>
<td>16</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(16)</td>
<td></td>
</tr>
<tr>
<td>Intense gingivitis</td>
<td>20</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(10)</td>
<td></td>
</tr>
<tr>
<td>Advanced periodontal involvement</td>
<td>20</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5)</td>
<td></td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No treatment</td>
<td>20</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0)</td>
<td></td>
</tr>
<tr>
<td>Oral health instruction</td>
<td>20</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0)</td>
<td></td>
</tr>
<tr>
<td>Prophylaxis &amp; oral health instruction</td>
<td>20</td>
<td>13</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(13)</td>
<td></td>
</tr>
<tr>
<td>Peridontal therapy - no extraction</td>
<td>20</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>Peridontal therapy &amp; extraction</td>
<td>20</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0)</td>
<td></td>
</tr>
</tbody>
</table>
10.9.4  WHO (1977) Index: Inter-examiner Variation

There was variation in the number of subjects affected by the various disease states when assessments made by the writer was compared to the assessments made by Associate Professor P.D. Barnard (Table 42).

The most marked variation was in the number of subjects with intense gingivitis when the writer assessed only 6 subjects as having intense gingivitis compared to 12 subjects assessed by Barnard. There were also variations in the number and the mean number of segments affected with the various categories with statistically significant differences in the scoring of intense gingivitis and advanced periodontal involvement. The mean number of segments (±SD) affected with intense gingivitis was 0.65 ± 1.1 assessed by the writer compared to 1.85 ± 2.2 assessed by Barnard. The mean number of segments affected with advanced periodontal involvement was 0.40 ± 0.9 assessed by the writer compared to 0.20 ± 0.7 assessed by Professor Barnard. There was slight variation between the two examiners in the assessment of treatment needs.
### Table 4.2 Duplicate examination

**WHO (1977) index: inter-examiner variation**

<table>
<thead>
<tr>
<th>Status</th>
<th>N</th>
<th>SUBJECTS AFFECTED</th>
<th>SEGMENTS AFFECTED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number</td>
<td>%</td>
</tr>
<tr>
<td>Soft deposit</td>
<td>20</td>
<td>18 (19)</td>
<td>90 (95)</td>
</tr>
<tr>
<td>Calculus</td>
<td>20</td>
<td>16 (19)</td>
<td>80 (95)</td>
</tr>
<tr>
<td>Intense gingivitis</td>
<td>20</td>
<td>6 (12)</td>
<td>30 (60)</td>
</tr>
<tr>
<td>Advanced periodontal involvement</td>
<td>20</td>
<td>4 (2)</td>
<td>20 (10)</td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No treatment</td>
<td>20</td>
<td>1 (0)</td>
<td>5 (0)</td>
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<tr>
<td>Oral health instruction</td>
<td>20</td>
<td>2 (2)</td>
<td>10 (10)</td>
</tr>
<tr>
<td>Prophylaxis &amp; oral health instruction</td>
<td>20</td>
<td>16 (15)</td>
<td>80 (75)</td>
</tr>
<tr>
<td>Periodontal therapy - no extraction</td>
<td>20</td>
<td>1 (3)</td>
<td>5 (15)</td>
</tr>
<tr>
<td>Periodontal therapy &amp; extraction</td>
<td>20</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
11. DISCUSSION

11.1 THE CPITN INDEX

11.1.1 Periodontal Status and Treatment Needs

Subjects 15 years and over:

Periodontal disease was found to be highly prevalent amongst the study population, affecting 98 percent examined to various degrees. The majority of the periodontal disease observed was of mild to moderate severity, with 3 percent of subjects having gingivitis only, 9 percent with calculus only and 71 percent with moderate periodontitis. Advanced periodontal disease was seen in only 15 percent of the population with the mean number of sextants affected per subject being 0.3. Even the percentage of subjects with one or more sextants affected with pockets 6 mm or more was only 15 percent. In these subjects with deep pockets these were limited or confined to a mean of 1.9 sextants per subject affected.

It was evident that as the age increased, there was a progressive increase in the proportion of subjects with one or more sextants affected with the more severe forms of the disease. No advanced periodontal disease was evident in those 15-19 years. The older age groups had higher mean sextant scores for pockets 6 mm or more. However, the mean number of sextants affected per subject affected was higher for the 20-29 age group (2.2) compared to the 30-44 and 45-64 age groups (each 1.8) who also had more missing sextants.
The percentage of subjects and the mean number of missing sextants per subject were positively associated with age.

The highest proportion of subjects with one or more sextants requiring treatment was for oral hygiene instruction and scaling (94%) with the mean number of sextants requiring treatment being 3.4. Only 15 percent of the subjects had one or more sextants requiring complex treatment and the mean number of sextants with complex treatment need per subject was low at 0.2. This suggests that the greater part of treatment required was such that it could be managed by dental officers and hygienists. Even for the 15 percent of subjects requiring complex treatment, periodontal surgery may not be required for all the sextants with pockets 6 mm or more. There is increasing evidence that a non-surgical approach (i.e. patient motivation, instruction in oral hygiene, scaling and root planing) will be successful in effectively treating deep periodontal pockets and maintaining clinical attachment levels (Lang 1984). From longitudinal studies, it appears that the "critical probing depth" at which non-surgical procedures would provide more favourable healing than flap procedures, may be greater than previously considered (Knowles et al 1979, Lindhe et al 1982).

The 30-44 year olds seem to be the group most in need of treatment with 100 percent of the subjects having one or more sextants requiring oral hygiene instruction and scaling and 22 percent requiring complex treatment.
The mean number of sextants per subject with treatment need 2 (OHI + Scaling) was 3.9 for those 30-44 years and 2.4 for those 15-19 years. These figures can be compared (in Appendix 9) to data from some other countries collected by the WHO Global Oral Health Data Bank.

Periodontal status assessed by Srikandi (1982) of 680 industrial employees in Adelaide aged 17-64 years using the CPITN index (partial recording) revealed 11 percent of the subjects having gingivitis only, 10 percent having calculus only, 60 percent with pockets greater than 3 mm and less than 6 mm and 23 percent with pockets 6 mm or more (advanced periodontal disease).

First year dental students, University of Sydney:
Prevalence and severity of periodontal disease in the dental students was lower than in the 15-19 and the 20-29 year olds at Assessment & Diagnosis.

As for treatment needs, none of the students required complex treatment, 5 percent did not require any treatment, 4 percent required oral hygiene instruction only and 91 percent required both oral hygiene instruction and scaling. The major treatment required was oral hygiene instruction and scaling with 91 percent of subjects having one or more sextants requiring the treatment with the mean number of sextants per subject being 2.6. Forty five percent of the subjects had one or more sextants requiring oral hygiene instruction, with a mean number of sextants per subject being 0.9. Treatment required by this group was such that it can be managed by non-specialist dental resources.
11.1.2 The Methodology

Criteria used for diagnosing periodontal status and translating status into treatment needs was found to be simple, relatively reliable, scientifically based and objective. Gingivitis is probably best diagnosed at the clinical level by the occurrence of bleeding on gentle probing (Oliver 1976). The detection of bleeding from a probed site is an objective sign that is recorded as either present or absent. No visual changes are recorded, thus reducing examiners decision on the subtle, complex and subjective evaluation of changes in colour, contour and consistency of the tissues. Studies reviewed have also shown that bleeding on probing is an objective, clinical criteria which reliably reflects histopathological changes associated with gingivitis and periodontitis.

Gingivitis is generally considered to be the earliest stage of periodontal disease and is reversible with treatment. A good gingival index should, therefore, be capable of detecting the earliest stage of periodontal disease, since prevention of periodontal disease is actually the treatment of initial gingivitis. It has been shown histologically that bleeding on probing is an earlier sign of gingivitis than the visual recognition of gingival inflammation (Mühleman & Son 1971, Meitner et al 1979).

From the literature reviewed it is evident that bleeding on probing is considered to be the most valuable diagnostic criteria in evaluating gingival health or disease. The bleeding symptom being readily reversible can also function as a motivating factor for the patient towards better oral home care.
Periodontal probing, despite its limitations, is the best available measure of the presence and severity of periodontal disease. The CPITN is the only index so far designed by WHO to measure periodontal treatment needs which relies on the routine use of the periodontal probe.

Pressure is one of the most important variables in measuring pocket depth and bleeding tendencies. Investigators have called for standardisation of probing forces in measuring pocket depth and bleeding tendencies if consistent and reliable clinical or research data is to be obtained. The methodology for the CPITN states that a probing force of no more than 25 G should be used. Most investigators regard a force of between 10 - 25 ponds (1 pond = 1 gram absolute) to be in the mid range of "gentle" probing forces as determined by experienced clinicians. Pressure sensitive probes are now available commercially for examiner calibration purposes.

The use of the WHO 621 periodontal probe (i.e. standardisation of the shape, size and weight of the probe) with a standard probing pressure of no more than 25 G enhances the objectivity of the gingival bleeding criteria and probing depth measurement. During this study, objectivity was further enhanced by standardised points of application in the gingival crevice or pocket from which measurements were taken.

It was stated in the publication by Ainamo et al (1982) "if neither deep or moderate pocketing, nor calculus, is observed, but bleeding
occurs after probing, code 1 is given to the sextant examined". The bleeding demonstrated in the methodology, therefore represents the total potential for bleeding from a crevice, whether deepened or not. Since bleeding may occur from gingivitis or periodontitis, it is absolutely critical that an accurate diagnosis of the source of bleeding be established for accurate assessment and treatment. To measure gingivitis, a positive bleeding score should only be assigned if there is no periodontal pocket. The presence of both bleeding and pocket is considered a sign of active periodontitis and may indicate a need for surgical intervention. Bleeding from a pocket in the absence of marginal inflammation is one of the criteria of progressive chronic periodontitis. Bleeding from the base of the pocket is said to be a much more critical diagnostic feature than the actual depth of the pocket (Holborow et al 1983). Therefore, as long as examiners make a correct diagnosis of the source of bleeding, the methodology which provides for the total potential of bleeding from a crevice, deepened or not, is useful in diagnosing periodontal status.

The 621 periodontal probe was specially designed with a coloured band to allow easy differentiation of gingival crevices with a depth of up to 3 mm, pockets 4-5 mm, and pockets 6 mm or more. This would also help in examiner standardisation. The writer found the lightness of the probe encouraged gentler probing and its fineness enabled penetration to the bottom of the pocket without causing discomfort to the patient. On the whole, it was found that the probe could be easily manipulated in the oral cavity without discomfort to the patient. A sample of the Morita probes used during the survey were checked for accuracy. It was found that their accuracy was adequate, with the
lower marking being 3.5 with a standard deviation of 0.05 mm and upper marking 5.5 ± 0.12 mm.

Goldman and Cohen (1973) regard up to 3 mm as normal crevice depth. In this study subjects with pocket depths 4-5 mm were considered to have moderate periodontal disease; and subjects with pocket depths 6 mm or more to have advanced periodontal disease. The CPITN index detects in a meaningful way the clinical stages of the disease process; from reversible gingivitis, to moderate, and to advanced periodontitis, which is a desirable property of any index. The sole use of the probe enables the examiner to diagnose the categories of disease defined in the CPITN index: gingival bleeding after gentle probing; supra and subgingival calculus, moderate periodontal disease, and advanced periodontal disease.

It was noted that after constant use and sterilisation the colour coded band became faint and difficulty was experienced in differentiating the coloured from the non-coloured area even with excellent lighting conditions. A more distinct and brighter colour coded area would make differentiation easier, especially in field surveys. Manufacturers should also ensure that the coloured area does not become faint with constant use and sterilisation as occurred in this study.

Doubts have been expressed with regard to the use of probing in field surveys. One particular concern is that most surveys are carried out by dentists with little training and experience in probing. Horowitz
(1979) when reviewing epidemiological indexes for assessing the need for treatment of periodontal disease put forward some words of caution: "in inexperienced hands, a periodontal probe can become a treacherous weapon. For this reason, it may be best to determine advanced periodontal involvement for surveys solely from visual and digital observations".

Inter-examiner variations between the writer and Pritchard (a periodontist under whom the writer was trained) and between the writer and Barnard who had not received this training, were compared. On a worst mouth score 100 percent agreement was obtained by the writer with Pritchard and 75 percent agreement with Barnard. On an individual sextant basis, 89 percent agreement was obtained with Pritchard but mean sextant scores were similar. Individual sextant agreement was low at 60 percent with Barnard who recorded mean sextant scores considerably lower for pockets but there were no significant differences in the scoring of bleeding and calculus.

Analysing the result of inter-examiner variation between the writer and Barnard indicated that with untrained examiners, the main difficulty would be in scoring of pockets. In this study, there was under-estimation of pocket depth by the untrained examiner. Under-estimation of pocket depths could result from inadequate positioning of the probe, particularly with respect to angulation (Zeigler & Allan 1978). Over-estimation could result from excessive force used. If clinical evaluations are to be well correlated to the condition in reality, emphasis should be placed in probing techniques (Hassell et al 1973, Vitek et al 1979).
It is suggested that the better reproducibility obtained by the writer with Pritchard compared to Barnard was due to the preliminary training period with Pritchard. During the period spent at the Periodontic Unit, the writer was trained by Pritchard to use the probe at standardised points of application, probe pressure and angulation. Other criteria or doubts with regard to the use of the CPITN index were well defined between these two examiners. Acceptable reproducibility was only achieved through the training period. This strongly indicates that examiner training and calibration is mandatory if measurements are to be reproducible.

A study by Abbas et al (1982) also indicated that if examiners are trained to use the probe on a standardised site, in a standardised direction of insertion with a standardised probing force, credible data can be obtained after an examiner calibration and training period.

It can be said then, that if examiners are trained to take measurements at standardised points, with a standardised direction of insertion and probing pressure, reproducible data can be obtained after an intensive training period even with examiners who have little experience in probing. Examiner standardisation is essential in any survey whatever index is used. However, examiner training may present a problem in large field surveys if a number of examiners have to be trained and standardised. It would be preferable if a periodontist was involved in examiner training, since probing technique is so crucial in the use of the CPITN index.
The routine use of the probe also presents a few other problems in field surveys. A medical history will have to be obtained so patients with a history of rheumatic fever, valvular disease, cardiac arrhythmias, cardiac surgery or hepatitis B can be excluded from probing. Every patient with heart disease is susceptible to infective endocarditis and should have an antibiotic cover before any dental manipulation, which could cause a transient bacteraemia (Macleod 1977). Patients with a history of hepatitis should be excluded because of possible risks to the examiners (Navington & Varley 1976). Other "at risk groups" who require a hepatitis B test prior to probing would also have to be identified (e.g. intravenous drug abusers, dialysis patients, patients with history of blood transfusions). Disposable gloves were used by all examiners during this study which adds extra cost and time when large samples are being examined. Another concern in field surveys would be the fact that adequate sterilisation may be more difficult than in surgery conditions. Good lighting is essential, if markings on the probe are to be read accurately. The use of the CPITN index would therefore present a few problems in large field surveys. On the other hand, since data assigned without probing is doubtful, somehow ways to overcome these problems will have to be sought.

The mean clinical examination time taken by writer for a full mouth examination was 5.5 minutes and for a partial recording was 3.1 minutes. The mean times taken by Pritchard and Barnard for partial mouth recordings were 2.8 and 3.2 minutes respectively. Ainamo et al (1982) stated that time needed for the CPITN in recording six segment scores should not exceed 1-2 minutes. The longer time taken during
this study was due to the fact that each tooth had 4 separate probings done, with all measurements being called out and recorded. There was also a different recorder each day and this necessitated constant examiner checking to ensure recordings were done correctly. The time taken by a sample of dental officers, using 4 probings for the 10 index teeth was 1-2 minutes (mean 1 minute 20 seconds). Only the highest sextant scores were recorded and probings stopped when a score of 4 was obtained for any index tooth in a sextant.

Use of CPITN index:

The CPITN index was found to be a simple, reliable and appropriate method of classifying periodontal status, which can be easily translated into treatment needs. It also provides simple treatment guidelines for the vast majority of the patients. Those patients with gingivitis and calculus only can be referred directly to the hygienist for plaque control instruction and prophylaxis. Those patients with moderate periodontitis (pocket depths 4-5 mm) may be scheduled for non-surgical periodontal therapy followed by a re-evaluation appointment. At this appointment a full charting (charting of all areas) has to be done as a baseline measurement for future reference. Pocket depth measurements should be re-evaluated, after which further treatment, referral or recall may be prescribed. It has been shown that pockets of up to 5 mm in depth can be maintained without further destruction, by plaque control combined with scaling and root planing (Oliver 1975). Patients with advanced periodontal disease (pocket depths 6 mm or more) can be immediately referred to the periodontist for a more comprehensive and detailed periodontal examination and
treatment. It can be said a screening procedure has been developed which will rapidly identify those in need of treatment. The CPITN index is particularly useful as a screening examination in a hospital situation, such as the Westmead Centre Dental Clinical School. Patients can be screened at the Assessment & Diagnosis Department and then appropriately referred to either the hygienist, dental officer or periodontist.

A thorough and comprehensive periodontal examination is time consuming in busy general practice and if not carried out results in failure to diagnose patients even with moderate or severe periodontal disease. This is also due to inadequate diagnostic methods and the difficulty in translating findings into an effective treatment plan for the patient. The CPITN index provides a quick and dependable screening examination for the general practitioner. It can be used to determine whether periodontal treatment is required, give an indication of its extent and complexity, and can become a routine part of a dental examination. Its use would significantly improve the quality of periodontal care for dental patients. The CPITN index can also be used in evaluation of the patient's periodontal health and in setting goals. Croxson (1984) in his general practice found the index useful not only as a realistic screening examination for treatment needs but also in monitoring progress.

The CPITN appears to be a valid index for measuring periodontal disease status and their resultant treatment needs in a population. This may prove to be a valuable asset for persons responsible for
delivering oral care services to various population groups as well as for countries developing their oral care delivery system. One of the key reasons for converting epidemiological data into estimates of treatment needs is the resulting ability to quantify hours of treatment needed and the relative ease of comparing the different periodontal conditions using the common denominator of treatment time. Recording treatment needs in sextants, allows estimation of treatment time required for each patient by calculating the number of sextants in need of treatment. Identifying the number of individuals in need of treatment, the quality, the type and times required for treatment, provides feasibility for manpower and cost calculation. For example, subjects assigned treatment codes 1 and 2 can be managed by hygienists and dental officers and those assigned code 3 will need specialist treatment. Taking into account local availability of resources and associated factors, the number and type of manpower needed can be determined and its cost calculated.

Although average times have to be assessed locally, the writer feels some guidelines are much needed as a basis for calculating time required for carrying out the different treatment procedures. The only guidelines readily available for time, are treatment times given on a quadrant basis published in the Technical Report Series (WHO 1978). If estimates of time are available they can be tested out and adjusted according to local factors.

The writer also disagrees that patients with calculus only (score 2) and patients with pockets 4-5 mm (score 3) should be classified together in the same category for treatment need (code 2). Patients
with pockets 4-5 mm may require, besides scaling and oral hygiene instruction, a root planing. Therefore, treatment type and time for patients having pockets 4-5 mm (score 3) would be different than for patients with calculus only (score 2). In the publication (Ainamo et al 1983) it was stated that patients with score 1 i.e. with pocket depths 6 mm or more, would require deep scaling and root planing. The writer believes that if estimates of treatment need and time are to be reliable and meaningful, subjects with calculus only (score 2) and patients with pockets 4-5 mm (score 3) should be kept in separate treatment need categories. Patients with disease status score 2 should be assigned code 2 for treatment needs and patients with disease status score 3 should be assigned a different code for treatment needs.

Reporting the number and percentage of subjects with periodontal treatment needs in age groups would facilitate identification of high and low risk groups, and assignment of priority groups for treatment. For example, 67 percent of the 15-19 year olds with gingivitis could indicate the weighted priority for "oral hygiene instruction only" compared to the 15 percent in the 45-64 or 26 percent in the 30-44 age groups. Groups most in need of treatment can also be identified. In this study, the 30-44 year olds, followed by the 20-29 year olds were most in need of treatment.

However, there are some aspects in the CPITN index that should be modified or defined more clearly for future users.
1. "There was no rule specifying the number of probings to be made" (Ainamo et al. 1982).

For the successful and dependable use of the CPITN index as a routine periodontal screening examination or in epidemiological surveys, essential information on disease prevalence and severity should be collected in a minimum possible time. For example, areas which are affected with the greatest disease incidence and severity, such as the interproximal areas should not be excluded in any probing examination. In Srikandi's study (1982) more than 90 percent of pockets detected occurred interproximally. Deepest pockets were also found interproximally in Pritchard's study (1978). An indication is needed to users of the minimum number of areas which have to be probed so that the most essential information could be obtained in a limited time and in a standardised manner.

2. Disease status scores of 2 and 3 should not be classified together as code 2 for treatment needs. Treatment requirements for patients with disease status scores 2 and 3 are different and should be separately reported.

3. The method recommends that calculus be assessed not so much as a measure of disease, but as a treatment need. However, the method did not provide for any distinction between supra and subgingival calculus which is necessary, if enhanced degree of accuracy in predicting type and time required for treatment is required.
4. The criteria for recording bleeding in the CPITN represent the total potential of bleeding from a gingival crevice, deepened or not. Since bleeding may occur from gingivitis or periodontitis, it is important that a correct diagnosis of the source of bleeding be established for an accurate assessment and consequent treatment. It was felt that this should be emphasised or highlighted in the publication, so that examiners using the index would be careful when diagnosing the source of bleeding after probing.

5. The clinical impression was that it was not necessary to wait for a full 30 seconds for bleeding to occur. In many cases after 30 seconds only pin points of blood were seen.

6. A number of methods of reporting the data have been mentioned. If periodontal status and treatment needs are to be compared on an international basis, a standard method of presenting data and reporting would help in making comparisons and in setting goals for periodontal health. A standard method of reporting data would also be useful to the Oral Health Global Data Bank, as it monitors the global changes and trends in oral disease.

7. The writer feels that scientifically based guidelines for estimating treatment times should be available on a sextant basis so that these treatment times can be adjusted to suit local conditions. It was stated in the publication (Ainamo et al 1982) that suitable procedures are being tested and more detailed recommendations will be developed. However, to date, there have not been any recommendations or guidelines reported.
11.2 VARIATIONS IN METHOD OF CPITN ASSESSMENTS

11.2.1 Partial versus Full Mouth Recording

In epidemiological surveys it is of considerable advantage to have a rapid, as well as an accurate, method of assessment (Greene 1967, Alexander 1970b). This would also apply to any periodontal screening examination.

Ramfjord (1974) compared the results of whole mouth examination with those of selected tooth surfaces and stated that "nothing is to be gained by examining 28 teeth thoroughly in each person when the periodontal appraisal is known to be very similar to that from the examination of the 6 teeth". There are many different opinions as to which teeth are suitable for use in partial mouth examinations.

When the CPITN index was first proposed (WHO 1978), Ramfjord's (1959) selection of index teeth was recommended for a partial mouth recording. After analysing data collected from 12 countries, the working group decided on 10 index teeth for partial recording (Ainamo et al 1982) instead of Ramfjord's 6 index teeth. A study by Srikanth (1983) in South Australia using Ramfjord's 6 index teeth, as a partial mouth recording for the CPITN index, detected only 19 percent of the advanced periodontitis as assessed by full mouth recording in subjects under 30 years of age, and only 27 percent in subjects 30 years and over.
In this study partial recordings using the 10 index teeth recommended by Ainamo et al. (1982) gave only a very slight under-estimation of the disease prevalence. Partial recording detected 79 percent of patients with moderate periodontal disease compared to 80 percent with full mouth recording, 11 percent of patients with advanced periodontitis compared to 13 percent with a full mouth recording (Table 15). However, the 2 patients (2%) that were not identified as having advanced periodontal disease by partial recordings were designated as having moderate periodontal disease. Clinically, this would not be significant, as patients having either moderate or advanced periodontitis would require a full charting after initial therapy. In the new patient with untreated periodontal lesions, probing depth measurements will tend to over-estimate the pocket depth. This error is likely to be 1-2 mm. Probing depth measurements obtained following initial therapy are likely to give the clinician a more accurate estimate of the true location of the pocket base than that obtained by pre-operative measurements (Listgarten 1980). It is therefore critical to re-evaluate all probing depth measurements following initial (non-surgical) therapy. Hence, the 2 patients assessed as having moderate periodontal disease instead of advanced periodontal disease would be clinically insignificant.

When mean sextant scores per subject and mean sextant scores per subject affected were considered, partial recording appeared to be proportionally less effective in detecting the more severe form of periodontal disease. However, differences noted were not statistically significant. Identical mean sextant scores per subject and identical
mean sextant scores per subject affected were obtained for bleeding on probing and calculus.

It can be concluded from the present study that examination of the ten index teeth recommended by Ainamo et al (1982) would be sufficient for use as a periodontal screening examination and in epidemiological surveys. A difference in examination time per person would assume greater magnitude when used in epidemiological surveys or as a screening examination. The writer found the partial recording easier to apply, required less effort, was more practical and would perhaps be easier to obtain reproducibility.

In an attempt to determine whether it was necessary to do 4 separate probings on each of the index teeth, the effectiveness of 2 probings per tooth was compared to that of 4 probings per tooth. Pritchard (1978) in his study concluded that the lingual aspect of the mandibular teeth should never be excluded from routine probing; and when lingual aspects of the mandibular posterior teeth and the buccal aspects of the maxillary posterior teeth were probed, the deepest crevice point will be found in 87 percent of patients examined. So the first combination of 2 probings tested was using the mesial and distal lingual measurements of the mandibular index teeth and the mesial and distal buccal measurements of the maxillary index teeth.

Ramfjord (1974) recommended the use of mesial measurements only, because he found a smaller examiner error for the mesial surface than for the distal surface. Ramfjord also recommended that buccal and lingual surfaces should be recorded separately because the
aetiological factors and treatment procedures may affect the buccal and lingual aspects of teeth in different ways. Therefore, the second combination tested was the mesial measurements of the buccal and lingual surfaces of the 10 index teeth.

Both combinations of two probings tested identified correctly all patients with gingivitis and calculus but under-estimated patients with moderate and advanced periodontal disease. The first combination detected 95 percent of patients with moderate periodontal disease and 76 percent of patients with advanced periodontal disease and overall there was 93 percent agreement (Table 19). On an individual tooth basis, for the total 1580 index teeth, there was 86% agreement when 4 probings were compared to 2 probings. This was almost similar to the results obtained by Pritchard (1978) in his study. Two probings per tooth gave the highest agreement at 91 percent for the mandibular molars followed by the maxillary molars at 86 percent. The second combination detected 97 percent of patients with moderate periodontal disease and 83 percent of patients with advanced periodontal disease. Overall there was 95 percent agreement.

Considering these results, it is suggested that when the 10 index teeth are used in a screening examination, (for example in Assessment & Diagnosis at the Westmead Centre Dental Clinical School), 4 separate probings should be done. This would enable more patients with advanced periodontal disease to be diagnosed and they could be directly referred to the periodontists. This method was found to be easily implemented by a sample of dental officers at the Assessment &
Diagnosis Department. Their time taken for the clinical examination was 1-2 minutes with a mean of 1 minute and 20 seconds.

However, it may be sufficient to use 2 probings per tooth in large epidemiological surveys where reduction of examination time would permit a more economical use of trained examiners and allow larger samples to be examined in the available time. In large epidemiological surveys where multiple examiners are involved, mesial measurements of the buccal and lingual surfaces would be suggested. It was not tested in this study if examiner error is smaller if only mesial measurements were used. However, mesial measurements are always easier to take and results of this study indicate that under-estimation of severity of slightly less than with the other combination. The literature reviewed indicated that the distal surfaces, especially of posterior teeth, are probed with the greatest amount of force. Two probings can also be used effectively for longitudinal studies.
11.2.2 Use of CPITN in Subjects under 20 years

False pockets associated with the eruption of permanent teeth in children and adolescents may constitute an over-estimation of treatment needs. In a Finnish study (Ainamo et al 1984a), at ages 12 and 17, false pockets were found mainly around second molars, where their prevalence was between 75-90 percent in the mandible and about 20 percent in the maxilla. Due to the false pockets present, around the 2nd molars in the Finnish study an average of 2.7 sextant per subject were assigned a treatment need of code 2 (i.e. oral hygiene instruction and scaling) compared to an average of only 0.3 sextants per subject when second molars were excluded and only the first molars and the two incisors were used as index teeth (6 index teeth).

In this study periodontal status assessed using 10 index teeth was compared to periodontal status assessed using 6 index teeth in all subjects in the 10-14, 15-19 age groups and in the 18 year old dental students. All 3 groups of subjects showed similar trends with major differences in periodontal status being in the scoring of pockets 4-5 mm. The number of subjects affected and the mean number of sextants affected per subject with pockets 4-5 mm were lower when the second molars were excluded. Examination of 6 index teeth only also increased the number of subjects and the mean number of sextants per subject with 'no disease'. Pockets 6 mm or more were not recorded in any of these 3 groups of subjects.

In subjects 10-14, using 6 index teeth, the mean number of sextants with pockets 4-5 mm was 0.9 and with no disease 3.8; with 10 index
teeth the mean number of sextants with pockets 4-5 mm was 1.2 and with no disease 3.5 (Table 22). There were no differences noted in the scoring of bleeding and calculus.

The greatest difference in scoring of pockets 4-5 mm when 6 index teeth were used instead of 10 was in the 15-19 year old subjects. Ten index teeth assessed 98 percent of subjects as having pockets 4-5 mm compared to 61 percent (Table 23). The mean number of sextants with pockets 4-5 mm was 2.7 compared to 1.8 with 6 index teeth, and with no disease was 1.7 compared to 2.4 with 6 index teeth.

For the 18 year old dental students, the mean number of sextants per subject with pockets 4-5 mm was 1.9 and with no disease 3.0 (with 10 index teeth) compared to 1.4 with pockets 4-5 mm and 3.5 with no disease when 6 index teeth used.

Greatest differences for scoring of pockets 4-5 mm in the 15-19 age group could probably be due to the fact that 67 percent of the subjects in this age group were 15 and 16 year olds with another 15 percent being 17 year olds. In the 10-14 age group, 45 percent of the subjects did not have any 2nd molars erupted (ages from 10-12).

As attachment levels were not recorded during this study, it is not known how many of these pockets were actually pathological and how many were false pockets. However, it would be logical to assume that the majority of these pockets that were recorded were 'false pockets' associated with erupting and newly erupted permanent teeth. In the study on 240 children aged 13-15 years by Ainamo et al (1984b) where
false pockets were differentiated from pathological pockets, no 'true pockets' were recorded. This finding was in agreement with the findings of Saxén (1980) in her study of bitewing radiographs of 8000 Finnish 16 year olds. A study on bitewing radiographs of 1731 school children aged 13-15 years revealed only 1 child exhibited bone loss (Blankenstein et al 1978). However, 40-50 percent prevalences of chronic periodontitis in the early and mid-teens have been reported (Hull et al 1975, Davies et al 1978). Such high percentages were explained as to differences in the choice of diagnostic criteria. (Lennon & Davies 1974, Blankenstein et al 1978, Ainamo et al 1984b).

Ainamo et al (1984a) stated that differentiation between a pathological pocket requiring professional treatment and a false pocket may be difficult, especially if bleeding is observed after probing of the false pocket. Analysis of their study indicated that the difficulty pertained to all permanent teeth at age 7 and for the 10 index teeth, in particular the second molars, at ages 12 and 17 years. Based on their study, Ainamo et al (1984a) suggested that in populations under 20 years of age CPITN recordings should be based on examination of only 1st molars and the 2 designated central incisors.

The writer also believes that in children up to 18 years exclusion of 2nd molars would prevent over-estimation of treatment need caused by the recording of false pockets. Pathological pockets in need of treatment can be reliably differentiated from a false pocket only by recording attachment levels. For specific evaluation for loss of attachment levels, direct measurements reported in millimetres from the cemento-
enamel junction are recommended over various other methods (Glavind & Löe 1967, Ramfjord 1974, FDI 1976). Recording of loss of attachment levels would require a periodontal probe graduated with 1 millimetre increments.

If the CPITN is to be used as a screening examination in large samples it would not be practical to measure attachment levels. This view was also shared by Lennon and Clevehugh (1984), where they stated that the measurement of loss of attachment is not a simple procedure and would not be suitable as a screening procedure for large groups of children.

Pathological pockets can also be differentiated from false pockets by assessing bone loss using radiographs. But, interpretational error plus discrepancies in angulation and film exposure techniques may all detract from radiographs their diagnostic accuracy in assessment of bone loss (Ramfjord 1974, Emslie 1974, Lang & Hill 1977). According to Lang and Hill (1977) early periodontal lesions are not detected from radiographs. Taking of radiographs is also not suitable when large samples of children are being screened. The rational approach therefore, when using the CPITN index as a routine screening examination for subjects aged 7-19, would be to use only 6 index teeth (excluding 2nd molars). If 2nd molars are included, the criteria for the CPITN index has to be modified as attachment levels have to be recorded to differentiate false pockets from pathological pockets actually in need of treatment, so that treatment needs are not over-estimated.
Gingivitis is considered to be the earliest stage of periodontal disease and may start as early as seven years of age. Sixty percent of the 6-9 and 65 percent of the 10-14 age groups demonstrated bleeding after probing, the indication for gingivitis. Gingivitis is reversible and can be prevented from progressing to periodontitis. It is therefore essential to screen all children from age 7 for gingivitis using the CPITN index. Ainamo et al (1984a) recommended that for children aged 7-11, recording of only the presence or absence of gingival bleeding (code 1) and dental calculus or overhangs of fillings (code 2) would be sufficient.
11.3 ASSESSMENT & DIAGNOSIS BY DENTAL OFFICERS VERSUS CPITN INDEX ASSESSMENT

In the Westmead Centre Dental Clinical School, patients in need of periodontal care are screened by dental officers at the Assessment & Diagnosis Department for appropriate referral to either the hygienists, dental officers or periodontists. However, with this periodontal screening examination, at Assessment & Diagnosis, not all patients were being adequately diagnosed and appropriately referred.

In Assessment & Diagnosis, examining dental officers were required to diagnose patients as having either moderate or severe periodontal disease and this was "ticked" on the routing slip in the patient record. Patients classified as having moderate periodontal disease are placed on the waiting lists for appointments to see the hygienists and dental officers; patients with severe periodontal disease are directly referred to the periodontist.

When assessments made by dental officers were compared to the CPITN index assessment, 94 percent of the subjects assessed by dental officers as having no disease were assessed with moderate periodontal disease (pockets 4-5 mm) by the writer using the CPITN index. Some 87 percent of subjects assessed as having mild periodontal disease, had moderate periodontal disease when assessed by the CPITN index. For 15 percent of the subjects assessed as having moderate periodontal disease by dental officers, severe periodontal disease (pockets 6 mm or more) was recoded using the CPITN. Evidence of periodontal disease was not recorded in 43 percent of the sample of subjects. It was of
concern that for this group for whom dental officers did not make a periodontal status recording, 63 percent had moderate periodontal disease and 17 percent had advanced periodontal disease. This group of patients in need of periodontal care would have no appointments specifically given for periodontal treatment. Findings from this study confirmed the dissatisfaction expressed with diagnosis and referral of patients by dental officers. Besides under-estimating the severity of disease, patients actually in need of periodontal care were allowed to go without treatment.

It was felt that patients were not correctly diagnosed as examining dental officers made subjective evaluation of periodontal status without the use of a periodontal probe. Use of the CPITN index would perhaps help make more correct diagnosis as the use of a probe is essential. The use of the CPITN index would also help identify patients with gingivitis only, who can be referred directly to the hygienist for oral health education. As discussed, bleeding on probing is the earliest sign of gingivitis and these patients should be referred to the hygienist and efforts should be made to prevent gingivitis from progressing into periodontitis through patients' education and motivation towards plaque control and oral home care. Patients with moderate periodontal disease can be referred to the hygienists and dental officers for initial (non-surgical therapy). Patients with pockets 6 mm or more can be referred directly to the periodontist for a more comprehensive and detailed periodontal examination and treatment. The CPITN index is sufficiently refined and sensitive to be used for routine periodontal screening examination in the Westmead Centre Dental Clinical School.
11.4 COMPARISON OF ASSESSMENTS BY CPITN AND WHO (1977) INDICES

When the WHO (1977) index treatment need assessment result for each patient was plotted against their corresponding disease status score as assessed by the CPITN index, it was apparent that the WHO (1977) index under-estimated the severity of periodontal disease in some patients. For 200 patients 15 years and over the WHO (1977) index assessed: 3 subjects as not requiring any treatment when they had pockets 4-5 mm; 19 subjects as requiring oral hygiene instruction when they had pockets 4-5 mm; 12 subjects as requiring oral hygiene instruction and prophylaxis when they had pockets 6 mm or more (which may be an indication of surgery); 111 patients as requiring oral hygiene instruction and prophylaxis when they had pockets 4-5 mm and may require root planing as well as oral hygiene instruction and prophylaxis.

This was because the periodontal probe was not used for the WHO assessment unless one or more of these signs (i.e. intense gingivitis, marked changes in gingival contour, suppuration and advanced gingival recession) were present, as stated in the manual (Oral health surveys: Basic methods 2nd ed. 1977). The manual states "if obvious mobility is not present but there are signs of one or more of the conditions mentioned, a periodontal probe is used to confirm the presence or absence of periodontal pocket".

However, significant tissue destruction and pocket formation may exist in the absence of any of the four conditions said to be accompanying
pocketing in the manual (McPhee 1977). This was also noted in this study. There were pockets 4-5 mm or even pockets 6 mm or more in the absence of any intense gingivitis, suppuration or recession. The other WHO (1977) index criteria for recording advanced periodontal involvement was definite tooth mobility which is a bad parameter of quantitative loss of support and destruction of periodontal tissue. Again deep pockets were present in the absence of definite tooth mobility. There does not seem to be a consistent relationship between loss of periodontal support and mobility. Many teeth with severe periodontal disease may not be mobile at all and conversely, a tooth may be mobile in the absence of periodontal inflammation.

Conversely, the WHO (1977) index also over-estimated the severity of periodontal disease. Out of the 40 subjects assessed as requiring periodontal therapy, 22 had pockets 4-5 mm, and 2 had calculus only when assessed by the CPITN index. The WHO (1977) criteria for recording advanced periodontal disease was a pocket 3 mm or more accompanied by one of the signs mentioned. Following the criteria, pockets more than 3 mm with gingival recession were recorded as advanced periodontal involvement. However, gingival recession present in some of these patients was the result of either past periodontal disease or therapy, or due to toothbrush trauma or anatomical features. Pockets 3 mm are too shallow to be taken as evidence of advanced periodontal involvement. The writer supports the CPITN methodology in excluding gingival recession and tooth mobility from the recordings.

"Intense gingivitis" in the WHO (1977) index was assessed by the subtle, complex and disputable interpretation of changes in colour,
contour and form of the tissues. The writer experienced difficulty in
deciding whether intense gingivitis was present or absent. Cutress et
al (1977) experienced much difficulty in examiner calibration when
diagnosing "intense gingivitis". In this study most marked inter-
examiner variation was in the scoring of intense gingivitis. The writer
assessed only 6 subjects as having intense gingivitis compared to 12
subjects by Barnard and there were statistically significant
differences in the mean number of segments recorded by the two
examiners. Bleeding on gentle probing was the criteria for recording
gingivitis using the CPITN index, which is dichotomous (recorded as
either present or absent) and has been proved clinically and
histologically to be the earliest and most reliable indicator of
gingival pathology.

The WHO (1977) index differentiates only "intense gingivitis" and
"advanced periodontal involvement", whereas the CPITN index diagnosis,
in a meaningful way, the progressive phases of periodontal disease.
This difference in the methods of assessment could also explain the
under- and over-estimation of the disease using the WHO (1977) index
compared to the CPITN index.

The WHO (1977) index assigned patients as requiring oral hygiene
instruction if soft deposits were present. In the CPITN methodology,
plaque levels were not assessed, as assessment of gingival
inflammation would have inherently included the consequences of the
presence of plaque, as well as the effect of the host resistance. As
both indices were designed primarily to measure treatment needs, the
CPITN index does identify patients actually requiring oral hygiene instruction.

Between non standardised examiners, there were variations using both the WHO (1977) index and the CPITN index. With the CPITN index the significant differences were in the scoring of pockets and with the WHO (1977) index, the significant differences were in the scoring of "intense gingivitis" as well as "advanced periodontal involvement". Examiner standardisation is essential for both indices. In the writer's opinion, examiner standardisation using the CPITN would be more easily achieved as the criteria are more objective.

It is possible to provide only a wide range of time required for treatment with the WHO (1977) index as treatment need was recorded for the whole mouth. Treatment need using the CPITN index was recorded for each sextant, providing a better basis for manpower calculations, how many persons can be cared for by each operator, and cost estimates for the delivery of care. Estimation of time requirements for care should be an essential ingredient of any index for measuring treatment needs.

The deficiencies of the WHO (1977) index have been reported by several authors (MoPhee 1977, Horowitz 1977, Cutress et al 1977) and in the writer's opinion their criticisms were valid.

It can be undoubtedly concluded that the criteria for recording periodontal status and translating them into treatment need using the WHO (1977) index was more subjective, less scientific and appropriate
compared to the criteria of the CPITN index. Prevalence and severity of periodontal disease can be reliably measured only by the routine use of a periodontal probe.

The WHO has been involved in designing indices for measuring periodontal treatment needs in large population groups since 1971. The CPITN is definitely a further refinement and improvement of the methods; and is the only index so far designed for measuring periodontal treatment needs, that is sensitive and sufficiently refined to be used as a routine periodontal screening examination.

Cutress et al (1977) stated that it is "important that new indices supersede well established indices only when their superiority is substantiated".

In the writer's opinion, the CPITN is definitely the superior index in screening for treatment needs, and should supersede the WHO (1977) index, and be recommended for international use.
12. CONCLUSIONS

1. Periodontal disease was highly prevalent amongst the study populations affecting 98 percent of subjects 15 years and over, 80 percent of subjects under 15 years, and 95 percent of the first year dental students. However, in most patients the disease was of mild to moderate severity. Advanced periodontitis was not evident in the first year dental students and subjects in the 15-19 and 6-14 age groups. For subjects 15 years and over, advanced periodontal disease was evident in only 15 percent of sample. There was a progressive increase in the severity of periodontal disease as age increased.

2. The major treatment requirement in all age groups could be categorised as "simple periodontal treatment" that can be managed by non-specialist dental resources. The mean number of sextants with need per subject for complex treatment was 0.2 compared to 3.4 for oral hygiene instruction and scaling. The 30-44 year olds seemed to be the group most in need of treatment.

3. The CPITN was found to be a simple, appropriate and meaningful index for recording various periodontal conditions and translating them into treatment needs. However, there are some aspects that should be modified or defined more clearly for future users if more accurate and reliable data are to be obtained.
Aspects requiring particular attention for the CPITN index:

(a) Providing users of the index with a possible minimum number of probing sites to find the deepest crevice points for effective and efficient standardised collection of data.

(b) Subjects with calculus only (score 2) and pockets 4-5 mm (score 3) should not be categorised together as treatment need code 2 (i.e. requiring oral hygiene instruction and scaling).

(c) A standardised method of reporting data should be recommended.

(d) Guidelines should be available for estimating time required to carry out different treatment procedures.

(e) Attention of manufacturers of the 621 probe should be drawn to the need for a more distinct and permanent colour coded area.

4. Examiner training and calibration is mandatory if reproducible data are to be obtained using the CPITN index. In field surveys, examiner training when multiple examiners are involved and problems associated with the routine use of a probe would present limitations in the use of this index. However, reproducible data can be obtained if examiners are trained to take measurements from a standardised point, with standardised direction of insertion (angulation) and pressures.
5. Partial mouth recording using the 10 index teeth is sufficient for use as a screening examination and for epidemiological surveys. Partial mouth recording using 4 separate probings for the 10 index teeth gave a good assessment of the full mouth appraisal of periodontal conditions of patients. Four probings of the ten (10) index teeth (mesial and distal interproximal areas of the buccal and lingual surfaces) appears ideal for a screening examination. Two probings of the 10 index teeth gave a "reasonable" assessment of the full mouth periodontal condition, and could be used in epidemiological surveys.

6. In subjects aged 12-19 years, there was obvious over-estimation of treatment needs which was probably due to the recording of false pockets around the second molars. A more rational approach in using the CPITN index in children under 20 would be to exclude the second molars from examination. If second molars are included, the index has to be slightly modified and provision should be made for differentiating a "false" pocket from a pathological pocket actually in need of treatment to avoid over-estimation of treatment needs.

Gingivitis was evident in the 6-9 age group, indicating that periodontal screening should be carried out for all children from the age of 7 years.
7. Screening assessments made by dental officers under-estimated the prevalence and severity of periodontal disease. Many patients in need of periodontal treatment were not diagnosed and were not given appointments specifically for periodontal treatment. The CPITN could be used as a practical alternative as a screening examination in Westmead Hospital. The index was found to be sufficiently refined and sensitive to be used as a routine periodontal screening examination.

8. The WHO (1977) index assessment under-estimated the severity of disease and, conversely, it also over-estimated the severity of the disease when compared to CPITN index assessment. This was because the criteria for measuring periodontal status and translating them into treatment needs using the WHO (1977) index were found to be subjective, less appropriate and scientific when compared to the CPITN index. The CPITN index, when compared to the WHO (1977) assessment, was found to have greater clinical application as a screening examination.
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Appendix 1 Daily summary of Assessment & Diagnosis patients
4 week period 14th May - 8th June, 1984

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<th>TOTAL A&amp;D N/SEEN</th>
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* days not worked  UTA Unable to attend  FTA Failed to attend
Appendix 2  Four probings per tooth versus two buccal or two lingual probings per tooth

Index teeth - worst tooth score
All index teeth

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<td>Total</td>
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<td>1580</td>
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Appendix 3

Four probings per tooth versus two buccal or two lingual probings per tooth

Index teeth - worst tooth score 17, 16, 26, 27

(80 agreements)

<table>
<thead>
<tr>
<th>4 Probe Score</th>
<th>SCORE - 2 Probing (Buccal/Facial) of 17, 16, 26, 27</th>
<th>4 Probe Total</th>
</tr>
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<tbody>
<tr>
<td>X</td>
<td>225</td>
<td>225 (100)</td>
</tr>
<tr>
<td>0</td>
<td>50</td>
<td>50 (100)</td>
</tr>
<tr>
<td>1</td>
<td>2  24</td>
<td>26 (92)</td>
</tr>
<tr>
<td>2</td>
<td>1  2  40</td>
<td>43 (93)</td>
</tr>
<tr>
<td>3</td>
<td>28  10  34  195</td>
<td>267 (73)</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>21 (43)</td>
</tr>
<tr>
<td>2 Probe Total</td>
<td>225  81  36  74  207</td>
<td>632 (86%)</td>
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### Appendix 4

Four probings per tooth versus two buccal or two lingual probings per tooth

Index teeth - worst tooth score 11

<table>
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<th>SCORE - 2 Probe (Buccal (facial) of 11)</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>4 Probe Total (% agreement)</th>
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<tbody>
<tr>
<td>0</td>
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<td>1</td>
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<td></td>
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<td>20 (75)</td>
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<td>14</td>
<td></td>
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<td>22 (64)</td>
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<tr>
<td>3</td>
<td></td>
<td>7</td>
<td>3</td>
<td>4</td>
<td>23</td>
<td></td>
<td>37 (62)</td>
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<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3 (67)</td>
</tr>
<tr>
<td>Duplicate Total</td>
<td></td>
<td>29</td>
<td>64</td>
<td>21</td>
<td>18</td>
<td>24</td>
<td>2</td>
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Appendix 5  

Four probings per tooth versus two buccal or two lingual probings per tooth

Index teeth - worst tooth score 37, 36, 46, 47

<table>
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<tr>
<th>4 Probe Score</th>
<th>Score - 2 Probing (Lingual of 47, 46, 36, 37)</th>
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<td>X</td>
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<tr>
<td>0</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>7 16</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6 1 21</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>14 10 13 213</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>5 18</td>
</tr>
<tr>
<td>2 Probe Total</td>
<td>279 56 27 34 218 18</td>
<td>632 (94%)</td>
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Comparison of CPII Scores

Appendix 6

Four probings per tooth versus two buccal or two lingual probings per tooth

Index teeth - worst tooth score 31

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<th>2 Probe Score</th>
<th>Duplicate Score (Lingual of 31)</th>
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<td></td>
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<tr>
<td>X</td>
<td>8</td>
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</tr>
<tr>
<td>0</td>
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<td>18</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Duplicate Total</td>
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Appendix 7  Duplicate examination

CPITN index: intra-examiner variation.
Worst mouth scores (Pritchard)

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<th>Original Total</th>
</tr>
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<tr>
<td>X</td>
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<td></td>
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</tr>
<tr>
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<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
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<td></td>
<td>16</td>
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<td>16 (100)</td>
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<tr>
<td>4</td>
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<td>4</td>
<td>4 (100)</td>
</tr>
<tr>
<td>Duplicate Total</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>4</td>
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(2 agreement)
Appendix 8  Duplicate examination
CPITN index: inter-examiner variation.
Worst mouth scores (Pritchard)

<table>
<thead>
<tr>
<th>Original Score Silva</th>
<th>DUPPLICATE SCORE - Pritchard</th>
<th>Original Total Silva</th>
</tr>
</thead>
<tbody>
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<td>1</td>
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</tr>
<tr>
<td>2</td>
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<td>4</td>
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<td></td>
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<tr>
<td>Duplicate Total Pritchard</td>
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( % agreement )
### Treatment Need 2 - Scaling

**8 (Sextants)**

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<th>30 - 44</th>
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<th>45 +</th>
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<td>Bangladesh</td>
<td>94</td>
<td>89 (3.5)</td>
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<td>38</td>
<td>100</td>
<td>(5.7)</td>
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<tr>
<td>China</td>
<td>50</td>
<td>74 (2.6)</td>
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<td>40</td>
<td>95</td>
<td>(3.3)</td>
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<td>20</td>
<td>95</td>
<td>(4.7)</td>
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<td>77</td>
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<td></td>
<td>80</td>
<td>100</td>
<td>(5.6)</td>
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<td>(5.9)</td>
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<td>(5.6)</td>
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<td>96</td>
<td>(5.6)</td>
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<td>70</td>
<td>96</td>
<td>(4.4)</td>
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<td>45</td>
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<td>37</td>
<td>96</td>
<td>(5.5)</td>
</tr>
<tr>
<td>Tonga</td>
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<td>(5.5)</td>
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<td>(5.9)</td>
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<td>(3.9)</td>
</tr>
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</table>

Source: 72nd World Dental Congress Helsinki 1984 Working Group presentation Barraes DE, Sardo-Infirri J