THE EFFECTS OF SCALING AND ORAL HYGIENE EDUCATION ON THE PERIODONTAL STATUS OF FACTORY WORKERS IN KENYA

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DECLARATION

I, Nyokabi Margaret Macharia, do hereby state that this dissertation is my original work and has never been submitted before, either in part or in whole, for another degree in any other University.

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DEDICATION

This dissertation is dedicated to my parents.

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ABSTRACT

This study was designed to determine the effects of scaling and of oral hygiene education (OHE) on the periodontal status of a group of 101 factory workers.

101 male factory workers aged between 30-50 years were selected from 2 milling factories in the Nairobi's industrial area. These workers were first subjected to a baseline examination after which they were randomly assigned to 4 intervention groups. The treatments were carried out three months after the baseline examination. Group 1, received scaling alone, group 2, scaling combined with OHE, group 3 OHE alone and group 4 received no treatment at all. A final examination was carried out 6 months following treatment.

There were no differences among the groups at baseline. For the final examination, there were statistically significant differences among the groups in: plaque score 2($F=4.24$; $P=0.008$), gingivitis score 0($F=3.31$; $P=0.0246$), supragingival calculus ($F=3.68$; $P=0.0158$), subgingival calculus ($F=41.48$; $P=0.0001$) and pocket depth ($F=2.87$; $P=0.042$).

An analysis of the changes that occurred within each group between the baseline and final examination indicated that there was a significant increase in the number of plaque free sites in all the treatment groups, $p<0.001$, $p<0.01$, $p<0.01$, and $p<0.05$ for

groups 1,2,3, and 4 respectively. The number of calculus free sites increased significantly, $p<0.001$ in both groups 1 and 2. This was mainly due to a decrease in the number of sites with subgingival calculus. These decreased significantly ($p<0.001$) in these groups, while in the groups that did not receive scaling i.e groups 3 and 4 the number of sites with subgingival calculus increased significantly ($p<0.01$ and 0.05 respectively).

The number of sites with supragingival calculus decreased significantly ($p<0.01$) only in group 1. A significant increase in the number of gingivitis free sites was observed in group 1 ($p<0.001$) and group 2 ($p<0.01$). Groups 1 and 2 demonstrated a significant increase in the number of shallow pockets ($p<0.01$, $p<0.01$ respectively) and a decrease in the number of deep pockets ($p<0.01$, $p<0.05$ respectively). In all the groups, the number of sites with attachment loss 0 mm increased significantly ($p<0.001$ in all the groups) while the number of sites with attachment loss 1-3 mm decreased significantly ($p<0.001$ for all the groups). However, the number of sites with attachment loss ≥ 4 mm showed a significant decrease ($p<0.05$) in group 2 only.

The effect of scaling was determined by comparing the "scaled" group (group 1+2) with the "non scaled" group (group 3+4). For plaque, scaling was found to have a significant effect ($p<0.05$) on plaque score 2 only. It had no effect on the number of plaque free sites (score 0). Scaling was found to significantly

($p<0.0001$) increase the number of calculus free sites. This was found mainly attributed to a decrease in the number of sites with subgingival calculus ($p<0.0001$). Scaling did not have a significant effect on the supragingival calculus. Scaling was associated with a significant increase ($p<0.003$) in the number of gingivitis free sites. Scaling also caused a significant reduction ($p=0.05$) in the number of deep pockets. Following scaling, the number of sites with attachment loss 0 mm increased significantly ($p=0.01$) while the number of sites with attachment loss 1-3 mm and ≥4 mm decreased significantly ($p=0.035$ and $p=0.021$ respectively).

In this study, scaling was found to improve all the periodontal parameters except for plaque. Scaling resulted in a limited improvement on the pocket depth and attachment level. The greatest effect of scaling was limited to the subgingival calculus. Scaling produced a significant reduction in the number of bleeding sites. OHE was not effective in this study. A combination of scaling and OHE did not offer any significant advantage over scaling alone.

Although scaling was associated with a statistically significant improvement in periodontal status over a six month period study, some deterioration was observed to have occurred after treatment on the supragingival calculus. Due to the poor plaque controlled in the scaled group, it is possible that a deterioration may have

occurred in the other periodontal parameters. This would not have been detectable in this study since it had only one post-treatment examination. Before scaling can be recommended as a method of treating periodontal disease in the community, better methods of controlling plaque should be sought. Also, a longer study with more post-treatment examinations should be carried out to determine the effects of scaling on the progression of the disease.

INTRODUCTION TO CHAPTERS

This thesis is organised into five chapters. The first part of chapter 1 comprises of literature review on periodontal disease, the global epidemiology, the prevalence of the disease in Kenya, the management and a summary of the findings on pathogenesis and treatment of periodontal disease. The second part of the chapter contains a statement of the problem in the current management of periodontal disease in Kenya and justification for further studies in this field. The aims and objectives and the hypotheses of the current study constitute the last part of chapter 1.

Chapter 2 contains the literature review. In this chapter, the literature has been divided into five sections. These sections include literature on the association of plaque and calculus and periodontal disease, calculus and periodontal disease, theories on the pathogenesis of periodontal disease, the effects of OHE on periodontal disease and the effect of scaling on periodontal disease.

Chapter 3 contains the methods and materials section. This chapter contains descriptions of the study area, the study design, the study population, the sample size determination, the selection and randomisation procedures. The methods and instruments used in the collection of data and the method and instruments used in the examinations indicated. The parameters and the criteria that were used to measure each parameter are

treatments. A time schedule for the study has been given. Also included in this chapter are the results of the intra-observer reliability and an outline of the analysis in this study.

Chapter 4 contains the results which are divided into five major sections. The first section includes results of the general characteristics of the population. Here the mean age and the general tooth status of the population has been given. Section 2 indicates the distribution of the number of individuals in the four treatment groups. Section 3 consists of the results of the comparison of the scores of various parameters in the four groups at the baseline examination. The fourth section consists of results of the comparison of the differences that occurred within the treatment groups between the baseline and final examination. The fifth section consists of the results of the comparison, between the "scaled" and "non scaled", between the "OHE" and "non OHE" and between the scaling only and scaling combined with OHE groups, of the differences that occurred in the various *parameters after treatment.*

Chapter 5 contains the discussion, conclusion, recommendations and limitations of the study. The final pages include the bibliography and the appendices.

CHAPTER 1

INTRODUCTION

This chapter contains a background on periodontal disease, statement of the problem in Kenya, aims, objectives and hypotheses.

1.1 Background

Periodontal disease is a term which refers to a group of diseases that cause destruction of the periodontium. Periodontal disease has been described as the most widespread disease of mankind (WHO, 1978). Different populations have been found to have different prevalence and severity of the disease. Information from the WHO Global Oral Data Bank from surveys carried out in different countries indicate that the prevalence and severity of periodontal disease may be greater in the developing than in the developed countries. The trends indicate that in developing countries the prevalence and severity remain high unlike in the developed countries where they appear to be decreasing (WHO 1984).

Very few studies have been published on prevalence and severity of periodontal disease in Africa. However, existing literature both to be fairly high in the region (Sheiham, 1981, Baelum, 1986, 1988, Budal et al 1985, Olssen, 1978). Akapbio (1970) reported that periodontal disease is universal in the

adult African. In their study on a rural population in Kenya, Baelum et al (1988) found that the majority of adult population exhibited gross accumulations of plaque and calculus. The population studied was considered representative of other rural populations in Kenya. Therefore, considering that approximately 80% of the Kenyan population is rural, it can be assumed that periodontal disease is widespread in the adult population in this country.

Periodontal disease is characterised by poor oral hygiene with accumulation of plaque and calculus on teeth surfaces, pocket formation, loss of attachment, gingival recession and gingival bleeding. The disease leads to loss of tooth support thus resulting in increased tooth mobility and migration that ultimately lead to tooth loss. According to a WHO report (WHO 1978), it was stated that periodontal disease "deprives many of their teeth long before old age." However, studies carried out in developed and developing countries over the last ten years indicate that caries rather than periodontal disease is the major cause of tooth loss (Ainamo, 1984, Baillit 1987, Kaimenyi 1986).

Conventional periodontal therapy involves removal of plaque and calculus deposits through scaling. This has for a long time been considered to be effective in controlling periodontal disease. The impression is based on observations from epidemiological studies which suggest existence of an association

between plaque/calculus and severity of periodontal disease (Loe.H, et al,1978).

Studies in literature indicate that scaling is effective controlling periodontal disease (Ramjford,S.P et al, 1973; Lindhe.J et al, 1982). However, unless done frequently, scalin has been found not to be effective in preventing progression o periodontal disease (Axelsson 1978, Soumi 1969). These studies found that conventional periodontal therapy, where scaling is done once or twice a year, is not effective in preventing progression of disease. A few studies have however, found tha scaling may cause deterioration of shallow pockets (Badersten 1981, Lindhe 1982).

The rationale for periodontal treatment has been that untreated periodontal disease progresses continuously in a lin fashion throughout the mouth and leads to an extensive amount tooth loss (WHO 1978) in all individuals. However, recent studies now indicate that the untreated disease progresses wit periods of activity and periods of remission (Socransky 1984, Goodson 1987). Other studies have shown that in a population, only a small portion of individuals are susceptible to rapidly progressive disease (Manji et al 1988, Jackson 1986). In most individuals, periodontal disease progresses slowly. This has been found true even in populations with high prevalence of po

oral hygiene conditions (Baelum et al, 1986, 1988, Loe et al, 1988).

In commenting on data collected from surveys done in different countries by the WHO, Barmes (1986) observed that different populations have different susceptibilities to periodontal disease. Baelum et al (1986) compared the results of studies on periodontal disease in different countries which also supported this view.

Studies carried out in East Africa seem to indicate that these populations are not very susceptible to the progression of periodontal disease (Manji 1988, Baelum 1986, Olsson 1978). In these populations, the rate of progression of untreated periodontal disease appears to be compatible with the retention of teeth in old age. According to Baelum (1988), this 'resistance' to periodontal disease progression may be due to the fact that the plaque and calculus deposits in these populations are undisturbed. It was stated in this study that "microbial deposits and calculus if left undisturbed may not necessarily be associated with the development of deep pathological pockets and extensive loss of attachment." If this is true then we should re-examine our management of periodontal disease in this country. Currently periodontal disease is treated by scaling. The finding that different populations may have different susceptibilities to periodontal disease is an indication that the disease may require

different ways of management in the various populations.

The fact that studies have indicated that scaling has to be done very frequently to be effective suggests that scaling is not the method of choice in treating periodontal disease on a public health basis, since it is not possible to carry out scaling more than once a year (and possibly longer) on a large population. However, before scaling can be dismissed altogether, it would be interesting to find out the effect on the periodontal status of scaling once a year as compared to giving OHE and no treatment.

Most studies on the effects of scaling on periodontal disease have been done in industrialised countries. No such studies have been published on Kenyans.

1.2 Statement of Problems and Justification for the Study

Although there are very few studies on prevalence of periodontal disease in Kenya, available evidence suggests that the disease is highly prevalent in the adult population (Akapbio 1970, Baelum 1988, Owino 1984). Currently, the management of periodontal disease in Kenya is by scaling. However, there have been no studies published so far on effectiveness of scaling in a population of Kenyans. Since susceptibility to periodontal disease may vary from one population to another, scaling might not necessarily be the best way of controlling periodontal

disease in all settings.

Published literature indicates that scaling is not effective in preventing the progression of periodontal disease unless it is performed frequently. The conventional approach to periodontal therapy ie. scaling once or twice a year, has been found to be ineffective in controlling progression of periodontal disease (Axelsson, 1978, Soumi 1969). Besides, scaling more than once a year is not practical on a public health basis; especially in a developing country where resources are scarce. The question that therefore arises is whether conventional therapy is better than no treatment at all, and whether cheaper options such as OHE can be more cost-effective.

Manji and Sheiham (1986) in a study on 9124 Kenyan children calculated that it would require 200 Kenyan dentists roughly 7-21 years of work (without follow-up) to treat just one cohort of 5-15 year olds. Considering that the adult population has a lot more deposits of calculus, it would be expected that more resources would be required to treat adults.

It is therefore important to determine the effectiveness of scaling before investing more resources in scaling as a way of controlling periodontal disease in Kenya. We should compare its effect with that of other cheaper options like oral hygiene education. Available evidence suggests that untreated periodontal disease does not always lead to extensive tooth loss (Baelum

1986, 1988, Olsson 1978) and that in some populations the rate of progression of the disease may be compatible with the retention of a functional dentition in old age in the majority of individuals (Manji 1988, Pilot 1986). Further, scaling may not always be necessary in some populations and that the improvement of oral hygiene measures through oral health education may prove to be a more cost-effective way of managing the disease. Studies in Kenya and Tanzania suggest that these populations may be "resistant" to periodontal disease and that the rate of progression of periodontal disease is relatively slow.

In the present study, the effects of scaling and oral hygiene education on the periodontal disease status of a group of Kenyan factory workers was determined and compared.

1.3 Aims and Objectives

Aims of the Study

The aim of this study is to determine the effect of scaling and oral health education (OHE) on periodontal status on an adult Kenyan population with minimal access to dental care over a 6 months follow-up period.

OBJECTIVES

1. To determine the effect of scaling alone on the amount of plaque, calculus, pocket depth, attachment loss and gingival bleeding.

2. To determine the effect of oral hygiene education alone on the amount of plaque, calculus, pocket depth, attachment loss and gingival bleeding.

3. To determine the effect of combining scaling and oral hygiene education on the above indicators of periodontal status.

1.4 HYPOTHESES (Alternate).

1. Scaling will produce a significant reduction in all the periodontal parameters.
2. OHE will produce a significant reduction in the amount of plaque but not calculus, pocket depth, attachment loss or gingival bleeding.

3. A combination of scaling and OHE will result in a more significant reduction in all periodontal parameters than scaling alone or OHE alone.

CHAPTER 2

LITERATURE REVIEW

In this chapter, the literature has been divided into five sections. The literature in the first section is concerned with the association of plaque and calculus with periodontal disease. The second section has literature which looks at the role of calculus in the aetiology of periodontal disease. The third section contains some literature on the theories of the pathogenesis of periodontal disease. The fourth and fifth sections deal with literature concerned with the effects of OHE and scaling on the periodontal status respectively.

2.1 Oral Hygiene Status and Periodontal Disease

Early epidemiological studies indicated a positive association between oral hygiene and periodontal disease (Emslie R.D. 1966, Sheiham A, 1970, Loe et al 1978). Loe et al 1978 found that the Sri Lankan population who had a worse oral hygiene status than the Norwegian population also had a higher severity of periodontal disease.

The aim of periodontal therapy is therefore to improve oral hygiene by removing plaque and calculus deposits from the tooth surfaces. In a clinical study, Loe et al (1965) demonstrated that gingivitis can be induced in previously healthy mouths by withdrawing oral hygiene measures and allowing plaque to accumulate. Re-institution of oral hygiene measures resulted in a

reversal of all signs of gingivitis and the gums reverted to their healthy state within a few days. This study demonstrated the importance of plaque in the development of gingivitis and the implications of the study was that had the plaque remained undisturbed for long enough, then periodontitis would have resulted.

Studies on experimental periodontal disease in animals appear to support this hypothesis. Leena S. (1985) cited a study by Lindhe et al (1973) in which they succeeded in producing *periodontitis in Beagle dogs by allowing plaque to accumulate on* their teeth *for 18 months. Periodontitis did not develop in the* control group of beagle dogs which received regular tooth brushing. Today, the importance of the role plaque plays in the aetiology and progression of periodontal disease is still accepted. The current belief is that periodontitis is a result of a sequential change of the bacteria found in plaque (Proceedings of Periodontology Today, 1988). The role of calculus in the aetiology of periodontal disease is however less clear.

2.2 Calculus and Periodontal Disease

Calculus has for a long time been assumed to be a major aetiological factor in periodontal disease. This is mainly because of the clinical observation of an association between calculus and periodontal disease. However, this role of calculus

in periodontal disease has been questioned. It has been suggested that calculus is a result rather than a causative agent of periodontal disease (Goldman H, 1986). In addition, it has been observed in a number of epidemiological studies that the correlation of plaque to the gingival health is stronger than the correlation between calculus and gingival health (Mandel et al, 1986). A general finding of some of the studies cited in the above review (Mandel et al) is that although sites with calculus tend to have gingival inflammation, there are many more sites with gingival inflammation which had no calculus. It would therefore appear that calculus may not be a necessary factor in periodontal disease pathogenesis.

The role of calculus in periodontal disease has been thought to be indirectly through bacteria embedded in its structure or directly through toxins and antigenic substances observed to permeate the calculus. This way, calculus is believed to promote the progression of the disease apically (Goldman, 1986). However, in a study using a scanning electronic microscope, Eide et al (1983) demonstrated a mineralised layer apical to the calculus on the root surface.

This surface coating was thought to contain toxic substances. If this is the case then this surface coating may play a more important role in the apical progression of periodontal disease than calculus. Whatever role calculus plays

in the aetiology and pathogenesis of periodontal disease, its removal from the tooth surface appears to be very important in the control of the disease. This has been demonstrated in several clinical studies (Tagge et al 1975, Cerek et al 1983).

2.3 Pathogenesis of Periodontal Disease

The rationale for conventional periodontal therapy is based on a model of periodontal disease in which the disease is believed to progress continuously in a linear fashion throughout the mouth. By this model, the disease is thought to progress continuously in the absence of treatment until tooth loss occurs (WHO 1978). However, this model of periodontal disease has been challenged (Socransky et al 1984, Goodson et al 1982).

Current literature suggests models of the disease in which destruction occurs in "bursts" at different sites of the mouth in a random fashion. In these models "active" and "inactive" sites occur in the same mouth. If this is true, then the rationale for treating all sites during therapy, as is done in conventional periodontal therapy, becomes obscure. Furthermore, the fact that a reversal of attachment loss has been observed to occur spontaneously without treatment in some sites (Lindhe et al 1983) appears to challenge the belief that healing of a site with periodontal disease cannot occur without treatment.

One of the reasons why periodontal therapy has been considered so important has been the belief that untreated periodontal disease causes a substantial amount of tooth loss before the age of 50 years. According to the WHO (1978), periodontal disease was said to deprive people of their teeth long before old age. However, recent studies on untreated periodontal disease indicate that the disease may be compatible with the long term retention of a functional dentition in some populations (Manji et al 1988, Baelum et al 1986, 1988).

2.4 The Effect of Oral Hygiene Measures alone on the Periodontal Status

The effect of oral hygiene measures in the periodontal status depends on the patients' compliance (Loos, 1988) which in turn depends on a number of social and psychological factors (Woodwal R.I. 1984). Oral hygiene measures have been shown to be effective in controlling gingivitis (Loe, 1965). The effect of oral hygiene measures alone on periodontitis is not extensively studied. In most of the studies in literature this effect has only been studied over short period of 2-6 months. There appears to be no studies on the long term effect of oral hygiene measures alone on untreated periodontal therapy.

The effects of oral hygiene measures on the periodontal status in untreated periodontal disease has been studied in a number of clinical experiments (Tagge et al 1973, Badersten et al

1984, Loos et al 1988, Cerek et al 1983). The general finding is that oral hygiene measures can reduce the plaque score significantly. However, the improvement on the bleeding score and pocket depth is limited. Minimal or no effect is observed on the attachment level.

The improvement of periodontal parameters appear to depend on the initial depth of the pockets. For plaque, lower plaque scores are obtained in shallow pockets ≤3 mm than in deep pockets. The bleeding score has a greater improvement in the shallower pockets. For the pocket depth, the greatest improvement occurs in the deep pockets (≥4 mm).

The improvement resulting from oral hygiene measures on untreated periodontal disease has been maintained for 3 months (Loos et al 1988, Badersten et al 1981) and 6 months (Cerek et al 1983). However, Cerek et al (1983) observed a deterioration of the attachment level after 8 months or oral hygiene measures alone. It would therefore seem that oral hygiene measures alone cannot control the progression of periodontal disease on a long term basis.

The limitation of oral hygiene measures on the control of periodontal disease has been attributed to its ineffectiveness in altering the subgingival microflora. Loos et al (1988) demonstrated that even when oral hygiene measures were complied

with, an alteration of the composition of the subgingival microflora did not occur.

2.5 The Effect of Scaling on the Periodontal Status

The effectiveness of scaling in improving the periodontal status is well documented in literature. Many of these studies are usually designed to compare the effects of surgical and non-surgical treatment modalities. The general finding of these studies is that both surgical and non-surgical periodontal therapies are equally effective in improving and maintaining the periodontal status on a short-term (Lindhe et al 1982) and on a long-term basis (Ramjford et al 1973). Other studies compare the effects of scaling and of oral hygiene measures alone on the periodontal status. These have indicated that the most marked improvement on the periodontal status occurs only after scaling (Badersten 1984, Cerek 1983, Tagge et al 1973).

Generally, scaling has been found to result in the improvement of all periodontal parameters. The magnitude of its effect appears to depend on the initial depth of the pockets. The reduction of the gingival score is more marked on the shallo pockets (≤3 mm). The greatest improvement of the pocket depth an attachment loss occurs in the deep pockets (Lindhe 1987). A deterioration of the pocket depth and attachment level after scaling has been observed in shallow pockets in a number of

studies (Lindhe et al 1982, Philstrom et al 1981, Badersten et al 1981).

The effectiveness of periodontal therapy also appears to differ with the different types of teeth. Non-molar teeth respond better to therapy than molar teeth (Lindhe et al 1982). Philstrom et al (1984) in a longitudinal study found that periodontal therapy significantly improved the periodontal status of both molar and non-molar teeth. There was a greater reduction in the pocket depth and attachment level in the pockets initially 4-6 mm in the non-molar than molar teeth. However, no difference was observed in pockets ≥7 mm.

Scaling has been found to produce a significant improvement of the periodontal status within a few weeks after therapy. Proye et al (1982) demonstrated a significant improvement of the pocket depth within 4 weeks after a single episode of root planning. This was attributed to be a result of gum recession and partly due to a gain in the attachment level. The bleeding score also decreases significantly within the same period.

The improvement on the attachment level obtained after therapy has been maintained unchanged or with little change for three years (Lindhe et al 1987) and over (Ramjford 1973). The most important factor in the long-term maintenance of the effects obtained after periodontal therapy is good post-treatment plaque

control. Where this is not adequate, a deterioration occurs. Pruthii V.K. (1986) in his review cited a histological study by Stahl et al in which the inflammatory infiltrate was observed to return to pre-treatment level after 52-60 days. This deterioration was attributed to the fact that no post-treatment plaque control measures were taken. Studies that have compared groups with good and poor post-therapy plaque control have found that in those groups with poor control, periodontal disease continued to progress while in those groups with good plaque control the disease was arrested, (Axlesson and Lindhe 1978, Soumi et al 1969). In a retrospective study on periodontal treatment without maintenance therapy, Becker W. et al (1984), stated that periodontal therapy without maintenance is of little value.

There were no randomised clinical studies in literature comparing the effects of scaling with those of oral hygiene measure alone on the periodontal status of populations with untreated periodontal disease.

CHAPTER 3

METHODS AND MATERIALS

This chapter contains a description of the study area, the study design, the study population, the sample size determination, the selection and randomization procedures in the first section. The instruments used in data collection, methods and instruments used in the oral examinations, indicators of periodontal status and their measurement are described in the second part. The third section is on treatment alternatives and instruments used for treatment. Finally, tables showing the time schedule, results of the intra-observer reliability and an outline of the analysis in the study are displayed.

3.1 Study Area

This study was conducted in 2 factories situated in the industrial area in Nairobi, the capital city of Kenya. The industrial area has about 2,000 factories lying approximately 5 Kms East of the city centre and stretching over an area of 200 Kms.

The two factories selected for this study were chosen from a list of "large" factories (i.e. with 200-300 factory workers) obtained from the Factories Inspectorate Department. These factories were selected on basis of convenience in terms of distance, large number of workers and availability of suitable

health care facilities at the work site. One of the factories chosen specializes in production of wheat flour and the other whole maize meal. Each factory had about 250-300 male and female workers excluding the managerial staff. The estimated male to female ratio was 3:1. Each factory had a well equipped dispensary where the examinations for this study were carried out.

3.2 Study Design

The study was a randomized clinical trial. A group of factory workers were selected and randomized into four treatment groups. Examinations were performed at baseline and six months following treatment.

The design of the study was factorial as illustrated below.

ORAL HYGIENE EDUCATION

SCALING	YES	NO	
NO	n_1	n_2	$n_1 + n_2$
YES	n_3	n_4	$n_3 + n_4$
TOTAL	$n_1 + n_3$	$n_2 + n_4$	N

This design facilitated the computation of a combination of scaling and O.H.E. It also offered an advantage in that a smaller study sample was needed than would have been with other designs.

3.3 Study Population

This comprised of all male factory workers aged 30-50 years from two milling factories; 147 from the wheat milling factory and 110 from the maize meal factory. Non unionized workers (management staff) were excluded from the study as they were considered to belong to a higher socio-economic status with better oral hygiene. They were more likely to have had scaling. A preliminary review indicated that non-unionized individuals in the study had minimal dental treatment.

3.4 Sample Size Determination

In order to demonstrate a difference between 2 groups of at least half a standard deviation with a significance (one sided) of 0.05 and a power of 0.80, it was found that 50 individuals in each group were required.

The equation used was:

$$n = \frac{2\,(k(\alpha) + k(1-\beta)\,\sigma^2}{d^2}$$

where n = required sample size per group

σ = the standard deviation in each individual observation

α = the required level of significance

β = the power of the test

d = the required difference between the 2 means where the difference is at least half a standard deviation.

3.5 Sample Selection and Randomization

Two lists of all male factory workers aged between 30-50 years were made, one for each factory. The lists included 147 names from the first factory and 110 names from the second factory. From each list, the workers were called one at a time to the factory dispensary. The purpose of the study was explained to each worker after which a verbal consent of their willingness to participate in the study was obtained. Those who were not willing to participate were immediately eliminated from the study. Those who were willing to participate were screened to further determine whether they were eligible for inclusion or not. A list of the names of all eligible subjects was then made to act as the sampling frame from which a total of 101 subjects were randomly selected; 51 from and 50 from the first and second factory, respectfully.

Using the sampling frame, subjects were randomized into 4 treatment groups of approximately equal sizes using a table of random numbers. There were 26, 26, 25 and 24 in groups 1, 2, 3, and 4 respectively.

3.6 Eligibility Criteria

3.6.1 Inclusion criteria:

1. Males 30 - 50 years.
2. non-unionized (non-management level staff)
3. Willingness to participate in the study.

3.6.2 Exclusion Criteria

1. Presence of pockets ≥4 mm on more than 4 teeth. It was felt that pockets ≥4 mm could not be adequately cleaned without surgery.

2. Subjects with medical conditions that could have affected periodontal status e.g. diabetes, epilepsy.

3. Subjects who had periodontal surgery or scaling over the previous 5 year period.

4. Any worker who was not available at the time of the preliminary examination (prior to study subject selection and randomization) for any reason.

3.7 Ethical considerations

1. An informed verbal consent for inclusion into the study was obtained from all the participants.

2. Pain relieving treatment was given as required. Dental advice among subjects who were randomized to non OHE groups was only offered on request. Even then, it was deliberately kept brief and strictly to the issue in question.

3.8 Data Collection

The following information was collected on a questionnaire

by a research assistant (appendix 1): name, age, brushing habits, type of brush used, smoking and drinking habits. Clinical examinations to determine the plaque, calculus, pocket depth, attachment loss and gingival bleeding scores were carried out before treatment (baseline examination) and 6 months after treatment (final examination). These examinations were done by the principal investigator and recorded on an examination sheet (Appendix II) by a research assistant. For each participant, the results at the baseline and final examination were recorded on separate examination sheets.

3.9 Oral Examination

Oral examinations were carried out with the aid of dental mouth mirrors and periodontal probes. These probes had markings at 3 mm, 5 mm and 8 mm. A lamp with a 40 watt bulb was used to illuminate the oral cavity during these examinations. The same instruments were used during the baseline and final examinations.

Both the baseline and final examinations were carried out by the principle investigator at the factory dispensaries. The baseline examinations were carried out before the treatments were done and the final examinations were carried out 6 months following treatment. The examinations were carried out using a periodontal probe to measure plaque, calculus, gingival bleeding pocket depth and loss of attachment scores in that order. These measurements were taken from the buccal, lingual, mesiobuccal and distobuccal aspects of all the teeth except the third molars.

Plaque was measured visually and by running a probe on the tooth surface. Calculus was recorded depending on the type of calculus that was present on the particular surface. Presence of subgingival culculus was identified using a periodontal probe and gingival bleeding by running the probe gently in the depth of the gingival sulcus.

Measurement of pocket depth and attachment loss from the buccal and lingual surfaces were taken along the flat surfaces of the molar teeth and within a distance of 2 mm on either side of the midline for the non-molar teeth, the highest measurements were recorded.The disto-buccal and mesio-buccal measurements were taken as close to the contact point as possible while keeping the probe parallel to the long axis of the tooth. The pocket depth and attachment loss were measured to the nearest millimetre using a periodontal probe. In many sites, the position of the cemento-enamel junction was estimated because it was difficult to probe it mainly because of the presence of calculus.

Tooth mobility and missing teeth were recorded. Missing teeth were recorded according to the causes of tooth loss. This was determined by inquiring from the patient as to the reason for tooth extraction. If the reason for a tooth extraction was presence of a hole, this was recorded as missing due to caries, if it was extracted because of mobility then it was recorded as

missing due to periodontal disease. Determination of missing teeth due to traditional extraction was made from an interview and examination (nearly always involved loss of lower anterior teeth only). It involved the lower anterior teeth only. Teeth missing due to other reasons included teeth that had been lost due to trauma and teeth that had not erupted.

3.10 Measurement Criteria

Plaque Score (Silness and Loe 1964)

0 = no plaque

1 = no visible plaque but plaque present on probing

2 = plaque visible without probing

3 = abundant plaque covering more than 1/2 the tooth surface or filling the proximal space.

Gingival inflammation (slight modification of index by Silness and Loe 1967).

0 = no bleeding

1 = slight bleeding

2 = profuse bleeding

3 = exudation of pus

Calculus Score (Bjorn and Loe 1967)

0 = no calculus

1 = supra gingival calculus

2 = subgingival calculus including dark staining calculus deposits in cases of gum recession

3 = both supra and subgingival calculus on the same surface

Pocket depth

This was measured with periodontal probe from the margin of the gingiva to the depth of the pocket. The measurement was taken to the nearest millimetre. Any pocket ≥8 mm was scored as "8".

Loss of attachment

This was measured with a periodontal probe from the cemento-enamel junction to the depth of the pocket. The measurement was taken to the nearest millimetre.

Tooth Mobility

0 = no mobility

1 = horizontal mobility <2 mm

2 = horizontal mobility >2 mm plus vertical mobility

Causes of tooth loss

0 = tooth present

1 = missing due to other reasons

2 = missing due to traditional extraction

3 = missing due to caries

4 = missing due to periodontitis

3.11 Treatments

These were carried out within 3 to 4 months after the baseline examinations. This delay was due to a problem in obtaining the scaling equipment. All treatments were administered by the same investigator to ensure consistency in therapy.

Treatment groups:

1. Scaling only
2. Scaling and O.H.E.
3. Oral hygiene education only
4. No treatment (Control)

3.11.1 Scaling

This was done using an sonic scaler with a Mijet (Meut model, no.T(XL033) at one sitting without local anaesthesia. Scaling of each individual took on average two and a half to three hours. Polishing was done on only a single occasion from 3 days to 2 weeks after scaling using a rubber cap or polishing brush using pumice mixed with prophylaxis paste. During polishing, any visible calculus was removed.

3.11.2 Oral Hygiene Education

Oral hygiene instructions were given individually to each participant in the groups receiving O.H.E. In the group that received a combination of scaling and OHE, the latter was given immediately after the scaling. A guide sheet (Appendix III) was used to standardize the instructions. No special brushing technique was taught.

No reinforcement of OHE was given for the rest of the study.

3.12 Schedule of the Study

	GP1	GP2	GP3	GP4	Month the procedure was done
Baseline Examination	+	+	+	+	Mid December to mid February 1988
Scaling and Polishing	+	+	-	-	Mid March to mid May 1989
Oral Hygiene Education	-	+	+	-	May
Final Examination	+	+	+	+	August to september 1989

3.13 INTRA-OBSERVER RELIABILITY

During the baseline and final examinations, every tenth worker examined had a second examination performed, on a randomly selected quadrant, 2 - 3 hours after the initial examination. The repeat examinations were done for calculus, pocket depth and attachment loss to determine the intra-observer reliability for these parameters. Repeat examinations for plaque and gingival bleeding were not feasible because the first examination introduced changes that interfered with the initial periodontal findings. For calculus, the simple agreement based on scores between the 1st and 2nd readings at the baseline and final examinations was 88% (see appendix IV).

For the pocket depth at the baseline examination, 100% of the 1st and 2nd readings agreed within ±2 mm, 99% of the reading agreed within ±1 mm (see appendix IV). At the final examination all the 1st and 2nd readings agreed within ±3 mm. However less than 1% of the sites differed by ±3 mm. The majority (97%) agreed within ±1 mm.

For the attachment level at the baseline examination, 100% of the 1st and 2nd readings agreed within ±3 mm. Majority of the readings (95%) agreed within ±1 mm. Only less than 1% differed by ±3 mm. At the final examination 100% of the 1st and 2nd readings agreed within ±2 mm. However majority of the readings (97%) agreed with ±1 mm (see appendix IV).

3.14 ANALYSIS

Only data from participants who were present at both the baseline and final examinations were used in the analysis. Those subjects who were supposed to have scaling or OHE or both but did not, for logistic reasons, but who were available at both examinations were analyzed in the "no treatment" group. Analysis of baseline characteristics suggested that the subgroup did not systematically differ from the other subjects in the randomized groups.

Analysis was done using an SPSS-PC statistical package. A comparison of the groups at the baseline examination for each parameter was done using an analysis of variance (ANOVA) on the number of sites with the different scores. A paired student's t-test was used to examine the differences that occurred within each group between the baseline and final examination. A comparison of the groups at the final examination was done by ANOVA on the differences that occurred within the groups in the number of sites with the different scores. A student Newman Keul's test was used on the results that indicated a significant difference to determine the source/s of differences.

To determine the effects of scaling on the periodontal disease groups 1+2 were combined into the "scaled" group which was then compared with the "non scaled" group (group 3+4). To determine the effects of OHE, group 2 and 3 were combined into the "OHE" group which was then compared with the "non OHE" group (group 1+4).

CHAPTER 4

RESULTS

This chapter is divided into five major sections. Section 1 contains the results of the general characteristics of the population. These include the mean age and age range, the general tooth status of the participants. Section two shows the distribution of the participants after randomization, at baseline and at the final examination. The third section contains results of the comparison of the groups at the baseline examination. The third section contains the results of the differences that occurred within the groups between the baseline and final examinations. Comparisons between the "scaled" and "non scaled" groups, the "OHE" and "non OHE groups", and the scaling only and scaling combined with OHE groups of the differences that occurred within them after treatment is contained in the fifth section.

4.1 GENERAL CHARACTERISTICS OF THE STUDY POPULATION

The study population comprised of 101 men. Their mean age was 39.5 years with a range of 30 to 50 years. Eighty-four percent of these workers claimed to brush their teeth at least once daily. Majority of these workers, (81.2%) brushed their teeth with a conventional toothbrush, while 17.8% used a chewing stick (mswaki). None of the participants used an anti-tartar toothpaste.

The dental treatment which had been received by the

participants in this study prior to the study was limited to dental extractions. There were no fillings in this study group and only one worker had received periodontal therapy ten years previously.

The total number of mobile teeth was 36.i.e roughly one mobile tooth in every third participant. However most of the mobile teeth were observed to occur in a few individuals only while in majority of the participants no mobility was observed.

The total number of missing teeth among study participants was 123. Of these, 77 (63%) were lost due to caries, 24 (20%) due to traditional extraction and 20 (16%) due to periodontal disease.

4.2 DISTRIBUTION OF STUDY SUBJECTS IN THE TREATMENT GROUPS

Table 1: Frequency distribution of subjects in the 4 treatment groups

Treatment	After randomization	During the baseline analysis	During the final analysis
Scaling only	26	26	24
Scaling + OHE	26	17	15
OHE	25	19	15
No treatment	24	39	25
TOTAL	101	101	79

After randomization the 4 groups had approximately equal numbers of subjects. During the analysis of the baseline results, the numbers in the groups changed following the decision to analyze results of subjects who were randomized to groups 1, 2 and 3, and who did not receive either scaling or OHE , with group 4 subjects. The number of individuals in group 1 (scaling only) remained the same. The group that had a combination of scaling and OHE and the OHE only group experienced a decrease in numbers while the number in the no treatment group increased. During the final examination, the total number of participants had decreased by 22. The number of subjects in each of the groups at baseline and final analysis are shown in table 1. A total of 2, 2, 4 and 14 subjects dropped out of groups 1, 2, 3 and 4 before the final examination respectfully.

Table 2: Percent distribution of subjects by treatment groups

Treatment	% of Participants		
	at randomization	at baseline analysis	at final analysis
Scaling only	25.7	25.7	30.4
Scaling + OHE	25.7	16.8	19.0
OHE	24.8	18.8	19.0
No treatment	23.8	38.6	31.6
TOTAL	100	100	100

4.3 COMPARISON OF THE GROUPS AT THE BASELINE EXAMINATION

4.3.1 Plaque

In all the groups the mean number of sites that were calculus free was less than 30. Majority (48-54) of the sites exhibiting plaque had little amounts of plaque (score 1). The mean number of sites with plaque score 2 in the 4 groups was between 30-33.The mean number of sites with great amounts of plaque (score 3) was slightly higher (2) in the OHE group than in the other three groups where they were less than one. Generally, the distribution of the various plaque scores is quite evenly distributed in the four groups.

Table 3a: Mean Number of Sites with Plaque Score 0,1,2,3 and standard deviations at baseline by treatment groups.

Treatment	Score			
	0	1	2	3
Scaling only	26.2 (21.4)	47.5 (20.2)	30.8 (24.8)	0.84 (2.1)
Scaling + OHE	21.8 (20.5)	53.7 (14.0)	29.9 (20.3)	0.88 (2.0)
OHE	25.9 (22.3)	46.3 (21.3)	33.3 (27.9)	2.47 (6.1)
No Treatment	23.0 (20.9)	51.3 (15.1)	32.8 (24.2)	0.72 (1.9)

The standard deviations are indicated in parentheses.

Table 3b: F and P Values for Plaque scores among treatment Groups at Baseline

Score	F-Value	P-Value
0	0.23	0.87
1	0.77	0.52
2	0.10	0.96
3	1.44	0.24

No Significant differences were observed among the groups.

4.3.2 Calculus

Table (4a) shows that the mean number of sites in the four groups that exhibited calculus was between 50 and 60. The mean number of sites with supragingival calculus (score 1) in the four groups was 6-8. Most (43-51) of the sites had subgingival calculus.Only a few sites (a mean of less than 5 sites in all the four groups) had supragingival and subgingival calculus (score 3) on the same surface.

Table 4a: The Mean number of sites with calculus score 0,1,2,3 at baseline by treatment groups.

Treatment	Score			
	0	1	2	3
Scaling only	48.7 (28.2)	7.8 (5.5)	44.9 (26.5)	4.2 (11.8)
Scaling + OHE	51.8 (24.1)	5.6 (4.7)	45.9 (23.6)	1.6 (2.1)
OHE	56.8 (25.0)	6.3 (3.8)	42.5 (25.4)	2.3 (2.9)
No treatment	49.0 (23.4)	6.0 (2.4)	51.1 (22.1)	1.8 (2.4)

The mean number of sites with the various scores was similar in all the groups and no significant differences were observed (tables 4, 4b).

Table 4b: The F and P Values for the Differences in Calculus Between the 4 Groups at Baseline

Score	F-Value	P-Value
0	0.50	0.68
1	1.12	0.34
2	0.67	0.57
3	0.51	0.67

4.3.3 Gingivitis

The groups on table 5a below show that the mean number of sites having gingivitis in the four group was between 62-66 sites; majority (57-61) had mild bleeding (score 1). The mean number of sites with gingivitis score 2 was between 3-6. The mean number of sites with pus (score 3) was less than 1 in all the groups.

Table 5a: Mean Number of Sites with Gingivitis Score 0,1,2,3 and the standard deviations at baseline by treatment groups

Treatment	Score			
	0	1	2	3
Scaling only	44.0 (25.5)	56.7 (24.6)	4.7 (9.9)	0.04 (0.20)
Scaling + OHE	39.1 (23.0)	61.0 (21.9)	5.8 (5.9)	0.12 (0.5)
OHE	45.5 (21.4)	57.4 (18.8)	5.0 (5.2)	0.0 (0.0)
No Treatment	45.0 (21.4)	59.4 (23.7)	3.4 (4.0)	0.1 (0.4)

Table 5b ; F and P Values for the Differences in Gingivitis Between the Treatment groups at Baseline.

Score	F-Value	P-Value
0	0,28	0,84
1	0,16	0,93
2	0,65	0,58
3	0,62	0,60

There were no significant differences between the groups in the mean number of sites with the various scores for gingivitis (tables 5a ,5b).

4.3.4 Pocket Depth

Majority of the sites had shallow pockets. The mean number of sites with shallow pockets in the four groups was between 101-103. Deep pockets were few and the mean number of sites with deep pockets was 5 or less in all the groups.

Table 6a: Mean Number of Sites with Shallow (≤3 mm) and Deep (≥4 mm) Pockets and the standard deviations at Baseline.

Treatment	Score	
	≤3 mm	≥4 mm
Scaling only	101.7 (9.8)	3.7 (4.6)
Scaling + OHE	101.0 (8.2)	5.1 (5.4)
OHE	103.4 (3.8)	4.7 (5.5)
No Treatment	103.3 (7.8)	4.6 (5.1)

Table 6b: F and P Values for the Differences in Pocket Depth Between the Groups at Baseline

Score	Differences	
	F-Value	P-Value
≤3 mm	0.43	0.74
≥4 mm	0.33	0.80

There were no significant differences between the groups either in the mean number of shallow pockets or in the mean number of deep pockets (tables 6a, 6b).

4.3.5 Attachment Level

Table 7a below indicates that on average the individuals in the four groups had lost some attachment on most (over 70) of their sites. Most (66-67) of the sites had lost 1-3 mm of attachment. The mean number of sites with attachment loss of 4 mm or more was less than 8 sites in all the groups. The mean number of sites without attachment loss was between 33-35 in the 4 groups.

Table 7a: Mean Number of Sites with Attachment Loss 0 mm, 1-3 mm, ≥4 mm and the standard deviations

Treatment	Score		
	0	1-3	≥4 mm
Scaling only	33.2 (27.0)	66.7 (21.5)	5.5 (12.9)
Scaling + OHE	35.4 (23.8)	66.8 (23.7)	4.0 (4.0)
OHE	34.4 (22.9)	66.3 (21.4)	7.2 (11.9)
No Treatment	33.7 (27.0)	65.5 (22.5)	7.6 (11.2)

There were no significant differences between the groups in any of the attachment levels (tables 7a, 7b).

Table 7b: F and P Values for Differences in Attachment Level Between the Groups at Baseline

Score (mm)	F-Value	P-Value
0	0.28	0.99
1-3	0.001	1.0
≥4	0.52	0.67

4.4 THE DIFFERENCES THAT OCCURRED WITHIN THE GROUPS BETWEEN THE BASELINE AND FINAL EXAMINATION

The differences between the two examinations were obtained by subtracting the baseline results from the final results. A paired t-test was used to determine whether the differences that occurred were significant.

4.4.1 Plaque

The mean number of plaque free sites increased in all the groups. The highest increase (25) was in the scaling combined with OHE group and the smallest (9) was in the 'no treatment' group. In the scaling only, scaling combined with OHE and the OHE groups, the mean number of sites with plaque score 1,2,3 decreased. In the 'no treatment' group, the mean number of sites with plaque score 1 decreased while the mean number of sites with plaque score 2 and 3 increased by 6 and 1 sites respectively.

Table 8: Means of the Differences in the number of sites with plaque score 0,1,2,3 in the treatment groups

Treatment	Score			
	0	1	2	
Scaling only	18.17 (12.21)	-5.54 (22.35)	-12.46 (22.07)	-0.13 (2.98)
Scaling + OHE	25.33 (23.56)	-13.87 (17.81)	-11.60 (20.20)	-0.20 (18.94)
OHE only	17.89 (16.23)	-6.00 (15.15)	-10.60 (19.20)	-0.93 (5.36)
No Treatment	9.25 (19.47)	-16.4 (18.94)	6.25 (22.05)	-0.92 (3.13)

An analysis of the differences on table 8 indicated that there was a significant increase in the number of plaque free sites in all the groups at the final examination ($t=3.93$, $p<0.001$; $t=3.60$, $p<0.01$; $t=4.26$, $p<0.01$; $t=2.45$, $p<0.05$) for groups 1,2,3 and 4 respectively).

4.4.2 Calculus

The mean number of calculus free sites increased greatly in the scaled groups by 35-37 sites while in the groups that did not receive scaling, an increase by 4 sites occurred in both groups. The mean number of sites with supragingival calculus (score 1) changed by 4 sites in the scaling only group, while in the other three groups there was little change. The greatest decrease in calculus occurred in the subgingival calculus.

e mean number of sites with subgingival calculus decreased by -33 sites in the scaled group. while in the groups that did not ceive scaling, an increase of 6 sites occurred in both groups. e biggest decrease (5) in the mean number of sites with score 3 lculus occurred in the scaling only group.

ble 9: Means of differences in the number of sites with Calculus score 0,1,2,3 in the Treatment groups

Treatment	Score			
	0	1	2	3
Scaling only	39.17 (20.56)	-3.92 (5.16)	-30.92 (19.50)	-4.50 (12.29)
Scaling + OHE	35.07 (18.4)	-0.46 (3.96)	-32.93 (19.04)	-1.60 (2.38)
OHE only	-4.07 (8.50)	-0.67 (2.47)	5.93 (7.62)	-0.80 (2.96)
No Treatment	-3.88 (9.89)	-1.12 (3.03)	5.60 (9.25)	-0.32 (1.65)

n analysis of the differences on table 9 indicated that there as a significant increase ($t=9.33$, $p<0.001$; $t=7.37$, $p<0.001$ in roups 1 and 2 respectively) in the number of calculus free sites n the groups that received scaling. The number of sites with upragingival calculus decreased significantly ($t=3.70$, $p<0.01$) n group 1 (scaling only). There was no significant change in he other groups.

The number of sites with subgingival calculus decreased significantly ($t=7.77$, $p<0.001$; $t=6.69$, $p<0.001$) in groups 1 (scaling only) and 2 (scaling combined with OHE) respectively, while in groups 3 (OHE only) and 4 (no treatment), a significant increase occurred ($t=3.03$, $p<0.01$; $t=2.34$, $p<0.05$, respectively). There was no significant change in the number of sites with supragingival and subgingival calculus on the same surface (score 3)in any of the groups.

4.4.3 Gingivitis

The mean number of gingivitis free sites increased in all the groups and especially in the scaled groups. The mean number of sites with gingivitis score 1,2 decreased in all the groups with the scaled groups having the greatest decrease. There was little change in score 3 gingivitis in all the groups.

Table 10: Means of differences in the number of sites with Gingivitis score 1,2,3 in the Treatment groups.

Treatment	Score			
	0	1	2	3
Scaling only	19.29 (23.62)	-15.08 (22.04)	-4.13 (10.00)	-0.042 (0.20)
Scaling + OHE	25.40 (26.78)	-19.20 (25.34)	-6.00 (6.00)	-0.13 (0.52)
OHE	8.33 (11.79)	-5.00 (12.75)	-3.00 (2.88)	0.0 (0.0)
No Treatment	6.12 (20.77)	-5.16 (19.92)	-0.64 (2.53)	0.0 (0.29)

An analysis of the differences in table 10 indicated that the mean number of gingivitis free sites increased significantly ($t=4.00$, $p<0.001$; $t=3.67$, $p<0.01$) in groups 1 and 2 respectively. In groups 3 and 4 no significant changes occurred.

4.4.4 Pocket depth

The mean number of sites with shallow and deep pockets changed by 2-3 sites only in the scaled groups while in the groups that did not receive scaling these hardly changed.

Table 11: Means of differences in the number of sites with shallow (≤ 3 mm) and deep (≥4 mm) Pockets in the Treatment Groups

Treatment	Score	
	≤ 3 mm	≥4 mm
Scaling only	2.29 (3.43)	-2.17 (3.06)
Scaling + OHE	2.60 (3.40)	-2.60 (3.48)
OHE	0.47 (2.59)	-0.27 (2.31)
No Treatment	0.72 (3.12)	-0.44 (3.02)

An analysis of the differences on table 11 indicated that the number of shallow pockets increased significantly ($t=3.27$, $p<0.01$; $t=2.95$, $p<0.01$) in groups 1 and 2 respectively. The number of deep pockets (≥4 mm) decreased significantly in these groups ($t=3.50$, $p<0.01$; $t=2.89$, $p<0.05$ respectively). There was no significant change in groups 3 and 4.

4.4.5 Attachment level

The mean number of sites with attachment loss 0 mm increased in all the groups. The mean number of sites with attachment loss 1-3 mm decreased in all the groups by approximately the same number of sites as those that increased in the attachment loss 0 mm. The mean number of sites with an attachment loss ≥4 mm decreased by 1-2 sites in the groups that received scaling and hardly changed in the groups that did not receive scaling.

Table 12: Means of the Differences in the mean number of sites with Attachment Level 0 mm, 1-3 mm, and ≥4 mm in the Treatment Groups

Treatment	Score		
	0 mm	1-3 mm	≥4 mm
Scaling only	37.08 (18.58)	-35.67 (18.52)	-1.25 (3.37)
Scaling + OHE	39.67 (18.36)	-37.93 (18.85)	-1.73 (2.58)
OHE	31.40 (18.37)	-31.47 (18.60)	0.04 (3.40)
No Treatment	26.68 (11.14)	-26.80 (12.14)	0.32 (3.82)

An analysis of the differences in table 12 indicated that the number of sites with attachment loss 0 mm increased significantly in all the four groups ($t=9.78$, $p<0.001$; $t=8.37$, $p<0.001$; $t=6.95$, $p<0.001$; $t=11.96$, $p<0.001$ for groups 1,2,3 and 4 respectively).

The number of sites with attachment loss 1-3 mm decreased significantly ($t=9.64$, $p<0.001$; $t=7.79$, $p<0.001$; $t=6.54$, $p<0.001$; $t=10.98$, $p<0.001$ for groups 1,2,3 and 4 respectively). The number of sites with attachment loss ≥4 mm decreased significantly ($t=2.58$, $p<0.05$) in group 2 only. There was no significant change in groups 1, 3 and 4.

4.5 BETWEEN GROUPS COMPARISON OF THE DIFFERENCES THAT OCCURRED WITHIN THEM AFTER TREATMENT

4.5.1 PLAQUE

4.5.1.1 Comparison of the Differences that Occurred in the 4 Groups for Plaque

The means of the differences in plaque scores in the four groups are shown in table 8. The number of plaque free sites increased in all the four groups. The number of sites with plaque score 1,2,3 decreased in the scaling only , the scaling combined with OHE and the OHE only groups. In the no treatment group, the number of sites with plaque score 1 decreased while those with plaque score 1 and 2 increased slightly.

No significant differences occurred between the four groups for plaque score 0, 1, 3. A significant difference occurred in the change that occurred in the number of sites with plaque score 2 ($F= 4.24$; $p= 0.008$). A student Newman-Keuls test indicated that this difference occurred between group 4 (no treatment) and the other three groups ($p<0.05$, $q=3.70$).

4.5.1.2 The Effects of Scaling on Plaque

This was determined by comparing the differences that occurred within the "scaled" group (i.e. group 1+2) with that which occurred within the "non scaled" group (i.e. group 3+4). (N.B. the same was done for the other parameters).

The number of plaque free sites increased in both the scaled and non scaled groups (table 13).The number of sites with plaque score 1 decreased in both groups. In the "scaled" group,the mean number of sites with plaque score 2 decreased by 12 sites while in the "non scaled" groups there was hardly any change. A significant difference between the two groups occurred in plaque score 2 only. There was little change in plaque score 3.

The "scaled" group had a significantly (F=2.15; P=0.05) greater decrease in the number of sites with plaque score 2 than the "non scaled" group. There were no significant differences between the groups in the change that occurred in the number of sites with plaque score 0,1,3.

Table 13: Means of differences in plaque score 0,1,2,3 in the "scaled" and "non scaled" groups.

Treatment Group	Score			
	0	1	2	3
Scaled (1+2)	20.92 (25.79)	-8.74 (20.68)	-12.13 (21.04)	-0.15 (2.57)
Non Scaled (3+4)	12.65 (18.56)	-12.65 (18.18)	0.1 (22.40)	0.23 (4.15)

4.5.1.3 The Effects of OHE on Plaque

This was determined by comparing the differences that occurred within the "OHE" group (i.e. group 3+4) with those that occurred within the "no OHE" group. (N.B. the same was done for the other parameters).

The number of plaque free sites increased in both the "OHE" group and the "non OHE" group. The number of sites with plaque score 1 and 2 decreased in both group. Little change occurred in plaque score 3 in both the groups.

There were no significant differences between the "OHE" group and the "no OHE" group in the change that occurred in the number of sites with any of the plaque scores.

Table 14: The means of the differences in plaque score 0,1,2,3 in the "OHE" and "no OHE" groups

Treatment Group	Score			
	0	1	2	3
'OHE' (2+3)	21.60 (20.24)	-9.93 (16.41)	-11.10 (19.28)	-0.57 (3.95)
'No OHE' (1+4)	13.74 (23.74)	-11.20 (21.21)	-2.78 (23.84)	0.41 (3.0)

4.5.1.4 Comparison of the Effects of Scaling only with Scaling Combined with OHE on Plaque

The number of plaque free sites increased in the both the scaled groups and in the group that did not receive scaling. This increase was greatest in the scaling combined with OHE group (table 15). The number of sites with plaque score 1,2 and 3 decreased in both the groups that received scaling. The decrease in the mean number of sites with plaque score 1 was higher (14) in the scaling combined with OHE than in the scaling only group where the decrease involved 6 sites.

There were no significant differences between the group that received scaling only and that which received scaling combined with OHE in the change that occurred in the number of sites with any of the plaque scores.

Tables 15: Means of the Differences in Plaque Score 0,1,2,3 in scaled (group 1 and 2) and the "non-scaled" (3 and 4) groups.

Treatment Group	Score			
	0	1	2	3
Scaling only	18.17 (27.21)	-5.54 (22.37)	-12.46 (22.07)	-0.13 (2.98)
Scaling + OHE	25.33 (23.56)	-13.87 (17.18)	-11.60 (20.02)	-0.20 (1.82)
Non-Scaled	12.65 (18.56)	-12.65 (18.18)	0.10 (22.40)	0.23 (4.15)

4.5.1.5 Comparison of the Groups that Received OHE only, Scaling Combined with OHE and the "No OHE" Group for plaque

The mean number of plaque free sites increased in all the three groups (table 16). The increase was highest (25) in the scaling combined with OHE group. The number of sites with plaque score 1 and 2 decreased in all the groups. There was little change in plaque score 3 .

There were no significant differences between the group that received OHE only (group 3), the group that received scaling combined with OHE (group 2) and the "non OHE" group (group 1+4)in the change that occurred in the number of sites with any of the plaque scores.

Table 16: Means of differences in plaque score 0,1,2,3 in group with OHE (2,3) and without OHE (1,4)

Treatment Group	Score			
	0	1	2	3
OHE only	17.87 (16.23)	-6.00 (15.15)	-10.00 (19.20)	-0.20 (1.82)
Scaling + OHE	25.33 (23.56)	-13.87 (17.18)	-11.60 (22.45)	-0.93 (5.36)
"Non OHE"	13.76 (23.74)	-11.20 (21.21)	-2.78 (23.84)	0.41 (3.07)

4.5.2 CALCULUS

4.5.2.1 Comparison of the Differences that Occurred in the 4 Groups for Calculus

The mean differences in calculus are shown in table 9. The number of calculus free sites increased in the scaled groups and decreased in the groups that did not receive scaling.
There were highly significant differences in calculus score 0 and 2 ($F=47.95$, $p=0.000$; $F=47.48$; $p=0.000$ respectively) between the groups. There was also a significant difference ($F=3.68$;$p=0.016$) between the groups in calculus score 1. There was no significant difference between the four groups in the change that occurred in the number of sites with calculus score 3.

A student Newman-Keul's test indicated that the differences in scores 0 and 2 occurred between the groups that received scaling (groups 1 and 2) and those that did not receive scaling (groups 2 and 3), $q=14.16$; $p,0.05$. The difference in calculus score 1 occurred between the scaling only group and the other three groups ($q=3.59$;$p<0.05$).

4.5.2.2 The effects of scaling on calculus

The number of calculus free sites increased markedly in the "scaled" group while in the "non scaled" group the sites decreased slightly. The number of sites with calculus score 1 (supragingival) and score 3 changed little in both groups.

The mean number of sites with calculus score 2 (subgingival) decreased markedly in the "scaled" group while in the "non scaled" group these sites increased slightly. (table 17) There was a significant difference (F=145.73, p=0.000) between the groups in the change that occurred in the number of sites with calculus score 0. There was no significant difference in between the groups in the change that occurred in the number of sites with calculus score 1 and 3. There was a highly significant difference (F=127.29,p=0.000) between the groups in change that occurred in the number of sites calculus score 2.

Table 17: Mean differences in number of sites with calculus score 0,1,2,3 in the "scaled" and "non scaled" groups.

Treatment Group	Score			
	0	1	2	3
Scaled (1+2)	37.59 (19.63)	-2.56 (4.99)	-31.69 (19.10)	-3.38 (9.78)
Non Scaled (3+4)	-3.95 (9.28)	-0.95 (2.81)	5.73 (8.53)	-0.50 (2.21)

4.5.2.3 The effect of OHE on calculus.

There was little difference in the number of sites with the various scores of calculus between the "OHE" and "non OHE"groups. The number of calculus free sites increased in both groups while the sites with calculus score 1,2,3 decreased in both groups. (table 18).

There were no significant differences between the "OHE"

(group 2+3) and "no OHE" group (group 1+4) in the changes that occurred in the number of sites with any of the calculus scores.

Table 18: Means of differences in the number of sites with calculus score 0,1,2,3 in the groups with OHE (2 and 3) and without OHE (1 and 4)

Treatment Group	Score			
	0	1	2	3
OHE (2+3)	15.50 (24.40)	-0.53 (3.25)	-13.50 (24.37)	-1.20 (2.67)
Non OHE (1+4)	17.20 (26.91)	-2.49 (4.40)	-12.29 (23.77)	-2.37 (8.85)

4.5.2.4 Comparison of the effects of scaling alone with scaling combined with OHE on calculus

The number of sites with calculus score 0 increased in both the scaling only and scaling combined with OHE groups.The differences in the number of sites with calculus score 0 were similar in both groups. The mean number of sites with calculus score 1,2,3 decreased in both groups. The greatest decrease occurred in the sites with calculus score 2.

There were no significant differences between the groups in the changes that occurred in any of the calculus scores except score 1 ($F=3.8$, $p=0.01$). From earlier results of a student Newmwan-Keul's test, the difference in the number of sites with calculus score 1 in the scaling only group was found to be significantly ($q=3.59$, $p<0.05$) different from those of the other groups.

The scaling only group had a significantly greater decrease in the number of sites with calculus score 1 than the scaling combined with OHE group.

Table 19: Means of differences in the number of sites with calculus score 0,1,2,3 in the scaled (1 and 2) and non scaled groups

Treatment Group	Score			
	0	1	2	3
Scaling only	39.17 (20.56)	-3.92 (5.17)	-30.92 (19.50)	-4.50 (12.30)
Scaling + OHE (2)	35.07 (18.44)	-0.40 (3.96)	-32.93 (19.04)	-1.60 (2.38)
Non scaled (3+4)	-3.95 (9.28)	-0.95 (2.81)	5.73 (8.58)	-0.50 (2.21)

4.5.2.5 Comparison of the OHE only group, the scaling combined with OHE group and the "no OHE" group for calculus

The number of calculus free sites (score 0) increased markedly in the group that received scaling combined with OHE while in the OHE only group these sites increased slightly. There was little difference between these two groups in the mean differences in the number of sites with calculus score 1 and 3. The number of sites with calculus score 2 decreased markedly in the scaling combined with OHE group while in the OHE only group these sites increased slightly.(table 20)

Table 20: Means of differences in the number of sites with calculus score 0,1,2,3 in groups with OHE (2 and 3) and without OHE (1 and 4).

Treatment Group	Score			
	0	1	2	3
OHE only	-4.07 (8.05)	-0.67 (2.47)	5.93 (7.62)	-0.80 (2.96)
Scaling + OHE	35.07 (18.44)	-0.40 (3.96)	-32.93 (19.04)	-1.60 (2.38)
OHE	17.20 (26.91)	-2.49	-12.29 (23.77)	-2.37 (8.85)

4.5.3 GINGIVITIS

4.5.3.1 Comparison of the differences that occurred in the 4 groups for gingivitis

The mean differences for gingivitis are shown in table 10. The number of gingivitis free (score 0) increased in all the groups. This increase was higher in the groups that received scaling. The number of sites with score 1,2,3 decreased in all the groups with the groups that received scaling having the highest increase. There was a significant ($F=3.31$, $p=0.025$) difference between the four groups in the change that occurred in the number of sites with gingivitis score 0. There were no significant differences between the groups in the changes that occurred in the number of sites with gingivitis scores 1,2,3.

A student Newman-Keul's test indicated that the difference in score 0 was between the groups that received scaling and those that did not receive scaling (3 and 4), ($q=3.69$; $p<0.05$).

4.5.3.2 The effect of scaling on gingivitis

The number of gingivitis free sites (score 0) increased in both the "scaled" and "non scaled" groups. The "scaled" group had a higher increase. The number of sites with gingivitis score 1,2,3 decreased in both groups. The decrease was higher in the scaled group. (table 21)

The changes in gingivitis score 0,1,2 in the "scaled" and "non scaled" groups were significantly different (F=9.23, p=0.003; F=6.33, p=0.014; F=5.32, p=0.024) respectively.

Table 21: Means of the differences in the number of sites with gingivitis score 0,1,2,3 in the scaled (1 and 2) and non scaled (3 and 4) groups.

Treatment Group	Score			
	0	1	2	3
Scaled (1+2)	21.64 (24.71)	-16.67 (23.12)	-4.85 (8.63)	-0.08 (0.35)
Non scaled (3+4)	6.95 (17.79)	-5.10 (17.39)	-1.53 (2.87)	0.0 (0.25)

4.5.3.3 The Effect of OHE on Gingivitis

The number of gingivitis free sites (score 0) increased in both the "OHE" and "non OHE" groups. The number of sites with gingivitis score 1,2,3 decreased in both groups. The mean differences were not very different between the groups although they tended to be slightly higher in the "OHE" group.(table 22) There were no significant differences between "OHE" group and "no OHE" group in the changes that occurred in the number of sites with of any of the gingivitis scores.

Table 22: Means of the differences in the number of sites with gingivitis score 0,1,2,3 in the groups with OHE (2 and 3) and without OHE(1 and 4)

Treatment Group	Score			
	0	1	2	3
OHE (2+3)	16,87 (22,10)	-12,10 (20,99)	-4,50 (4,87)	-0,07 (0,37)
Non OHE (1+4)	12,57 (22,96)	-10,02 (21,36)	-2,35 (7,35)	-0,02 (0,25)

4.5.3.4 Comparison of the Effects of Scaling alone with Scaling Combined with OHE on Gingivitis

The number of sites with gingivitis score 0 increased in both the scaling only and scaling combined with OHE groups. The number of sites with gingivitis score 1,2,3 decreased in both groups. The mean differences tended to be higher in the scaling combined with OHE group. (table 23).

There were no significant differences between the groups in the changes that occurred in the number of sites with gingivitis score 0,1,2,3.

Table 23: Means of the differences in gingivitis score 0,1,2,3 in groups 1, 2 (scaled) and 3, 4 (non scaled)

Treatment Group	Score			
	0	1	2	3
Scaling only (1)	19.29 (23.62)	-15.08 (22.04)	-4.13 (9.98)	-0.04 (0.20)
Scaling + OHE (2)	25.40 (26.78)	-19.20 (25.04)	-6.00 (6.00)	-0.13 (0.52)
Non Scaled (3+4)	6.95 (17.79)	-5.10 (17.39)	-1.53 (2.87)	0.0 (0.23)

4.5.3.5 Comparison of the group that received OHE only, scaling combined with OHE and the "no OHE" group for gingivitis

The mean differences in number of sites with gingivitis score 0 increased in both the OHE only and the scaling combined with OHE groups by a similar number of sites. The mean differences in the number of sites with gingivitis score 1,2,3 decreased in both groups. The scaling combined with OHE group tended to have a higher decrease. (table 24)

There were no significant differences between the groups in the changes that occurred in the number of sites with score 0,1,2,3.

Table 24: A comparison of means of differences in number of sites with gingivitis score 0,1,2,3 between groups 1, 2 (scaled) and 3,4 (non scaled).

Treatment Group	Score			
	0	1	2	3
OHE only (3)	25.40 (8.33)	-5.00 (25.34)	-3.00 (2.88)	-0.13 (0.52)
Scaling + OHE (2)	26.78 (11.79)	-19.20 (12.75)	-6.00 (6.00)	0.0 (0.0)
Non Scaled (3+4)	12.57 (22.96)	-10.02 (21.36)	-2.35 (7.35)	-0.02 (0.25)

4.5.4 POCKET DEPTH

4.5.4.1 Comparison of the differences that occurred in the 4 groups for pocket depth

The mean differences for pocket depth are shown in table 11.The mean differences that occurred in the number of sites with shallow and deep pockets in the groups that received scaling were few (2-3 sites). The shallow pockets increased and the deep pockets decreased. In the groups that did not receive scaling there was hardly any change in the pockets.

Although an analysis of the mean differences indicated that there was a significant difference ($F=2.87$; $p=0.042$) between the groups in the change that occurred in the deep pockets, a student Newman-Keul's test indicated that there were no significant differences.

4.5.4.2 The effect of scaling on pocket depth

The mean differences in the number of sites with shallow and deep pockets changed by a few sites (2) in the "scaled" group. The shallow pockets increased and the deep pockets decreased. There was hardly any change in the pockets in the "non scaled" group. (table 25).

The "scaled" group had a significantly (F=6.37, p=0.014) greater increase in the number of shallow pockets than the "non scaled" group. The "scaled" group also had a significantly (F=8.57, p=0.005) greater decrease in the number sites with deep pockets.

Table 25: Means of differences in number of sites with shallow (≤3 mm) and deep (≥4 mm) pockets in the scaled (1 and 2) and non scaled (3 and 4) groups.

Treatment Group	Score	
	≤3 mm	≥ 4 mm
Scaled	2.41 (3.38)	-2.33 (3.19)
Non scaled	0.63 (2.90)	-0.38 (2.74)

4.5.4.3 The effects of OHE on the pocket depth

The mean difference in the number of sites with shallow and deep pockets was small (1-2 sites) in both the "OHE" and "non OHE"groups. The number of shallow pocket increased while the deep pockets decreased in both groups by a similar number of sites. (table 26).

There were no significant differences between the "OHE" group (group 2+3) and the "no OHE" group in the changes that occurred in the shallow or deep pockets.

Table 26: Means of differences in number of sites with shallow (≤3 mm) and deep (≥4 mm) pockets in the "OHE" and "no OHE group

Treatment Group	Score	
	≤3 mm	≥4 mm
"OHE" (2+3)	1.53 (3.16)	-1.43 (3.14)
"Non OHE" (1+4)	1.49 (3.34)	-1.29 (3.13)

4.5.4.4 Comparison of the effect of scaling alone with scaling combined with OHE on the pocket depth

The increase in the number of sites with shallow pockets was similar in the scaling only and the scaling combined with OHE groups. The decrease in the number of sites with deep pockets was also similar in both groups. (table 27)

There were no significant differences between the scaling only and the scaling combined with OHE groups in the changes that occurred in the shallow and deep pockets.

Table 27: Means of differences in number of sites with shallow (≤3 mm) and deep (≥4 mm) pockets in "scaled" groups (1,2) and the "non scaled" group(3,4).

Treatment Group	Score	
	≤3 mm	≥4 mm
OHE only (1)	2.29 (3.43)	-2.17 (3.06)
OHE + scaling (2)	2.60 (3.40)	-2.60 (3.48)
Non OHE	0.63 (2.90)	-0.38 (2.74)

4.5.4.5 Comparison of the OHE only group, the scaling combined with OHE group and the "no OHE" group for pocket depth

The OHE only group had little change in the pocket depth. In the scaling combined with OHE and the "non OHE" groups, the number of sites with shallow pockets increased and the deep pockets decrease by 1-2 sites. (table 28)

There were no significant differences between the three groups in the changes that occurred in the pocket depth.

Table 28: Means of differences in number of sites with shallow (≤3 mm) and deep (≥4 mm) pockets in groups with (2,3) and without OHE (1,4).

Treatment Group	Score	
	≤3 mm	≥4 mm
OHE only (1)	0.47 (2.59)	-0.27 (2.31)
Scaling + OHE (2)	2.60 (3.40)	-2.60 (2.31)
Non OHE (3+4)	1.49 (3.34)	-1.29 (3.13)

4.5.5 ATTACHMENT LEVEL

4.5.5.1 Comparison of the differences that occurred in the 4 groups in the attachment level.

The mean differences for attachment level are shown in table 12. The number of sites with attachment loss 0 mm increased in all the groups while the number of sites with attachment loss 1-3 mm decreased by a similar number of sites. The number of sites with attachment loss ≥4 mm decreased by a few sites in the groups that received scaling while in the groups that did not receive scaling hardly any change occurred.

There were no significant differences between the groups in the changes that occurred in the number of sites with attachment scores 0 mm, 1-3 mm, ≥4 mm.

4.5.5.2 The effects of scaling on the attachment level

The number of sites with attachment loss 0 mm increased in both the "scaled" and "non scaled" groups. The increase was higher in the "scaled" group. The number of sites with attachment loss 1-3 mm decreased in both groups with the "scaled group having the greater decrease. The number of sites with attachment loss ≥4 mm decreased slightly in the "scaled" group while in the "non scaled" group there was very little change. (table 29)

The changes that occurred in the "scaled" and "non scaled group in the number of sites with attachment loss 0 mm were significantly (F=6.98, p=0.010) different. The changes that occurred in both groups in the number of sites with attachment loss 1-3 mm and ≥4 mm were also significantly different (F=4.60,p=0.035; F=5.60, p=0.021 respectively.

Table 29: Means of differences in number of sites with attachment level 0 mm, 1-3 mm and ≥4 mm in the "scaled" and "non scaled" groups.

Treatment Group	Score		
	0 mm	1-3 mm	≥4 mm
Scaled (1+2)	38.08 (18.29)	-36.54	-1.44
Non scaled (3+4)	28.45 (13.85)	-28.48 (14.85)	0.35

4.5.5.3 The effects of OHE on the attachment level

The changes that occurred in the attachment level were similar in the "OHE" and "non OHE" groups. The number of sites with attachment loss 0 mm increased in both groups while the number of sites with attachment loss 1-3 mm decreased by a similar number of sites. The number of sites with attachment loss ≥4 mm decreased by a few sites in both groups.(table 30)
There were no significant differences between the "OHE" group (group 2+3) and the "no OHE" group (group 1+4) in the changes that occurred in the number of sites with attachment loss 0 mm, 1-3 mm, and ≥4 mm.

Table 30: Means of differences in number of sites with attachment level 0 mm, 1-3 mm and >4 mm in the "OHE" and "no OHE" groups.

Treatment Group	Score		
	0 mm	1-3 mm	≥4 mm
"OHE" (2+3)	35.53 (18.12)	-34.70 (18.69)	-0.67 (3.16)
"Non OHE" (1+4)	31.76 (15.97)	-31.08 (16.08)	-0.45 (3.65)

4.5.5.4 Comparison of the effect of scaling alone with that of scaling combined with OHE on the attachment level

The changes in the number of sites having attachment level score 0 mm, 1-3 mm, and ≥4 mm was similar in the "scaled" and "non scaled" groups. The number of sites with attachment loss 0 mm increased in both groups while the number of sites with

attachment loss 1-3 mm decreased by a similar number. The number of sites with attachment loss ≥4 mm decreased by a few sites in both groups. (table 31)

There were no significant differences between the groups in the changes that occurred in attachment level 0 mm, 1-3 mm, ≥4 mm.

Table 31: Means of differences in number of sites with attachment levels 0 mm, 1-3 mm and ≥4 mm in the "scaled" (1,2) and the "non scaled" (3,4) groups

Treatment Group	Score		
	0 mm	1-3 mm	≥4 mm
Scaling only (1)	37.08 (18.58)	-35.67 (18.52)	-1.25 (3.37)
Scaling + OHE (2)	39.67 (18.36)	-37.93 (18.85)	-1.73 (2.58)
Non Scaled (3+4)	28.45 (13.84)	-28.48 (14.84)	0.35 (3.62)

4.5.5.5 Comparison of the OHE only group (group 3), scaling combined with OHE group (group 2) and the "no OHE" group (group 1+4)for the attachment level

The number of sites with attachment loss 0 mm increased in all three groups. The scaling combined with OHE group had a slightly higher increase than the other two groups. The number of sites with attachment loss 1-3 mm decreased in all the groups by a similar number of sites as those that increased in attachment loss 0 mm. The decreased was slightly higher in the scaling combined with OHE group than in the other two groups. The number

of sites with attachment ≥4 mm hardly changed in the OHE only and the "non OHE" groups while in the scaling combined with OHE group, the sites decreased by about 2 sites (table 32).There were no significant differences between the groups in the changes that occurred in the number of sites with attachment loss 0 mm, 1-3 mm, ≥4 mm.

Table 32: Means of differences in number of sites with attachment levels 0 mm, 1-3 mm and ≥4 mm in the OHE, scaling and without OHE (1,4).

Treatment Group	Score		
	0 mm	1-3 mm	≥4 mm
OHE only (3)	31.40 (17.51)	-31.46 (18.60)	0.40 (3.40)
Scaling + OHE (2)	39.67 (18.36)	-37.93 (18.85)	-1.73 (2.58)
Non OHE (1+4)	31.78 (15.97)	-31.08 (16.08)	0.45 (3.65)

CHAPTER 5

5. DISCUSSION CONCLUSION, RECOMMENDATIONS AND LIMITATIONS OF THE STUDY

This chapter contains the discussion of the results, the conclusion and the recommendations of the study. Some of the limitations of this study have also been outlined in this chapter.

5.1 DISCUSSION

5.1.1 General Characteristics:

The age range of this study population was within the range where most signs of periodontal are expected (Pilot.T.et al,1986). Although majority of the participants in this study claimed to brush their teeth regularly, the oral hygiene was found to be quite poor with an average of only 24 plaque free sites per individual. It was felt that subjects answered the question about the frequency of tooth brushing according to how often they thought they should have been brushing rather than what was actually done.

The total number of mobile teeth in this study group was 36 i.e. roughly one mobile tooth in every third or fourth individual examined. However, all the mobile teeth were observed to have occurred in a few individuals only. The total number of missing teeth was 123. Most (63%) of these had been lost due to caries rather than periodontal disease. Periodontal disease contributed to 16% of all the lost teeth. Other recent studies have similarly found caries to be a greater cause of tooth loss than periodontal

disease (Ainamo, J et al, 1984; Manji, F et al, 1988). Traditional extraction was found mainly in the older individuals (over 40 year olds) and contributed to 24% of all the missing teeth. Traditional extraction did not occur in those less than 35 years.

5.1.2 Distribution of the participants in the treatment groups

After randomization, the individuals were fairly evenly distributed among the four groups (table 1). Data on subjects who had been initially randomized to receive scaling, OHE or a combination of both, and who did not avail themselves for the interventions, were analyzed together with "no treatment" group (group 4). The other options would have been either analyzing their results with those of the groups to which they had been randomized or excluding them from the analysis completely. The combination with the "no treatment" group was felt justifiable since the baseline (pre-treatment) characteristics of the subgroup did not significantly differ from those of the primary groups of randomization. Analysis with initial groups of randomization would not have been clinically meaningful since they had no therapy at all while, on the other hand, total exclusion would have reduced the total sample size and hence the power of the study.

A total of 22 subjects dropped out of the study before the final evaluation. Reasons for dropping out included fear of being scaled and failure to attend the final examination due to

disappointment on realising that they had been randomized to the "no treatment" group. The latter may explain the high drop out rate in the "no treatment" group. Blinding was, unfortunately, not practicable in this kind of a study and subjects were therefore, aware of their groups of randomization.

5.1.3 Comparison of the groups at baseline

There were no significant differences between the groups in any of the periodontal parameters. In the groups majority of the sites were found to have plaque. Most of these sites had small amounts of plaque (score 1). There were only a few sites with great amounts of plaque (table 2). This result was thought to have occurred because many of the individuals attempted to clean their teeth before the examinations despite efforts to discourage them from doing so. Had this not happened, probably sites with plaque score 2 and 3 would have been found in these individuals.

Most of the participants in the four groups had calculus on more than half the number of sites in their mouth (table 3). The amount of calculus present in an individual was found to increase with age with those under 35 years having little calculus and those over 40 years having a lot more calculus. Most of the sites had subgingival calculus. The number of sites with supragingival calculus were relatively few and occurred mainly on the lower anterior teeth. Both subgingival and supragingival calculus occurred on the same surface on only a few sites. These were mostly interproximal surfaces of the low anterior teeth.

In majority of the participants in the four groups, gingival bleeding occurred on more than half their sites (table 4). Most of the bleeding was mild. There were very few sites having pus in this study population.

The majority of the pockets in this study group were shallow. The mean number of shallow pockets in all the four groups was over 100 (table 5). This resulted from one of the exclusion criteria that any individual with more than four teeth having a site with a pocket ≥4 mm was excluded from the study. However, it was observed that these individuals were quite few in the study population. In each of the factories, there were 3-5 such subjects in the study population. The attachment loss was mainly 1-3 mm. Again this may have occurred due to the exclusion criteria mentioned above. Most of the attachment loss in this study population was observed to occur on the lingual aspects of the teeth. In many sites with attachment loss greater than 4mm gingival recession had occurred and the associated pockets were not deep.

5.1.4 Differences in periodontal parameters within the four groups between the baseline and final examination.

Plaque

There was a significant increase in the number of plaque free sites in all the four groups at the final examination (table 8). Although the groups that received OHE (groups 2 and 3) were expected to have a greater increase in the number of plaque free sites than the groups that did not (groups 1 and 2), there were no significant differences between these groups in the increased number of plaque free sites. This may have resulted due to a filtering of the OHE from the group that received it to those that did not. It was quite possible for this to occur because the individuals of these groups work together. The increase in the plaque free sites in the groups that did not receive OHE may also have occurred because of an increase in awareness of their oral hygiene due to their involvement in the study. This awareness may have been encouraged by the fact that all the participants in the study were given free tooth brushes and toothpaste as an incentive for participating in the study.

Calculus

The number of calculus free sites (score 0) increased significantly in the groups that received scaling (groups 1 and 2) while in the groups that did not receive scaling (group 3 and 4) these sites decreased slightly (table 9). This decrease was mainly due to a decrease in the number of sites with subgingival

calculus. There was no significant change in the number of sites with supragingival calculus in the scaling combined with OHE group. However, surprisingly there was a significant decrease in these sites in the scaling only group. The reason for the scaling only group having a significantly greater decrease in the number of sites with supragingival calculus than the scaling combined with OHE group are not clear but it is an indication that the OHE was not effective. Had the OHE been effective we would have expected the plaque control in the scaling combined with OHE group to have been better than in the scaling only group and the reformation of the supragingival calculus would therefore have been lower in the former group.

In the groups that did not receive scaling the number of sites with calculus increased significantly. This increase was mainly due to a significant increase in the number of sites with subgingival calculus in these groups. The number of sites with supragingival calculus did not change significantly in these groups.

Gingivitis

A significant increase in the gingivitis free sites (score 0) occurred in the groups that received scaling. There was no significant change in the groups that did not receive scaling. Scaling therefore appears to have been effective in reducing the number of sites with gingival bleeding probably by creating a change in the subgingival flora in these sites. It is surprising

that this change could have been maintained for six months since the general OHE in both the groups that received scaling was poor. This may be an indication that gingival bleeding has a greater association with calculus than with supragingival plaque.

Pocket depth

A significant change in pocket depth occurred in only a few sites in the scaled groups. This was mainly because there were few sites with pockets ≥4 mm. Studies in literature have indicated that most of the change in pocket depth after scaling occurs in deep pockets (Lindhe,J,et al 1987). Sterne, J., in a paper published in the proceedings of a conference on periodontal disease in 1988, showed mathematically that a greater change can be expected in deeper pockets because of a phenomenon of regression towards the mean. There was no significant change in pocket depth in the groups that did not receive scaling.

Attachment level

The mean number of sites with attachment loss 0 mm increased by the a similar number of sites as those that decreased in the sites with attachment loss 1-3 mm. This was likely to have occurred due to a change in the measurement criteria between the baseline and final examination where an attachment level which was read 1-3 mm at baseline was read 0 mm in the final examination even though it had remained unchanged. This was quite possible because the measurement error for the attachment level

in this study was found to be ±3 mm. It was therefore difficult to differentiate between the 0 mm and 1-3 mm pockets.

5.1.5 The effects of scaling and OHE on the periodontal parameters

Plaque

Scaling did not have any significant effect on plaque. There was no significant difference between the scaled and "non scaled" group in the change that occurred in the plaque free sites (table 13). We would not have expected scaling to have produced much effect on plaque since it was done only once during the six months of the study. Improvement on the plaque free sites could only have been expected if the oral hygiene of the scaled individuals was good. However, scaling appears to have caused a significant decrease in the number of sites with plaque score 2 suggesting that it may have had an effect in reducing the amount of plaque on the tooth surfaces. This may have occurred because scaling reduced the number of sites with calculus which acts as a retention for plaque.

The OHE in this study did not create a significant reduction in the plaque free sites. There was no significant difference found between the "OHE" and "non OHE" group (table 14). The number of plaque free sites increased in both groups. As discussed earlier, this reduction may have been due to filtering of the OHE from the groups that received it to those that did not or it may have occur due an increase in awareness in oral hygiene

in all the groups resulting from their involvement in the study. Whichever was the case, the OHE was not very effective because despite a significant increase occurring in the plaque free sites by about 21 sites the mean number of plaque free sites after treatment was still less than half the total number of sites (assuming that the total number of sites per individual to be about 112 since the average tooth loss in the study population was less than 1 i.e 0.37) since the mean number of plaque free sites at in the groups at baseline was 22-26. For the OHE to have been effective a behavioral change in the participants was necessary. Studies in health education have found that for a behavioral change to occur in an individual, it is necessary to recall him a number of times for feedback and reinforcement (Woodhall, I.R, 1984). The OHE in this study was given only once and was therefore not adequate to produce a behavioral change in the participants. In this study, the OHE was only given once because it was felt that to give it more frequently would have unpractical on a public health basis.

A combination of scaling and OHE did not have any advantage over scaling alone in reducing plaque in this study. There was no significant difference between the group that received scaling only and that which received scaling in addition to OHE in the changes that occurred in plaque (table 15).

Calculus

Scaling resulted in a significant increase in the number of calculus free sites (table 17). This was mainly due to an decrease in the sites with subgingival calculus. The effect of scaling on supragingival calculus was not maintained over a six months period. In fact in the study, supragingival calculus was found to have reformed in some individuals at the time the OHE was been given i.e two weeks after scaling. The number of sites with supragingival calculus had returned to baseline levels at the final examination in the scaling combined with OHE group. OHE did not prevent the formation of calculus as may have been expected. The number of sites with supragingival calculus returned to baseline levels at the final examination in the scaling combined with OHE group. In the OHE only group the number of sites with subgingival increased significantly at the final examination (table 20). This is another indication that the OHE in this study was not very effective in creating an improvement in the plaque control in the participants.

Gingivitis

Scaling significantly reduced the number of sites with gingival bleeding. The number of gingivitis free sites were significantly fewer in the "scaled" than in the "non scaled" group (table 21). It was surprising that a significant reduction in gingivitis was maintained for six months considering that the plaque control in the scaled groups was poor. In their study on

experimental gingivitis, Loe.H et al,1965, found that gingivitis occurs within a few days where plaque control was poor. The above results may suggest that gingival bleeding has a greater association with calculus than with plaque. However, Mandel I.D et al,1986, in their review quoted studies which indicate gingival bleeding has a greater association with plaque than with calculus. Another possibility is that the gingival bleeding may depend on the amount of plaque on a surface. Low quantities of plaque (score 1) on a surface may not cause gingival bleeding while great quantities of plaque (score 2) result in gingival bleeding. This would explain the result that although the number of plaque free sites was not significantly different between the "scaled" and "non scaled"groups, gingival bleeding was reduced significantly in the "scaled" group where the number of sites with plaque score 2 also decreased significantly.

OHE did not have a significant effect on gingivitis in this study. There were no significant differences in the gingivitis scores between the "OHE" and "non OHE" groups(table 22). Combining scaling with OHE did not have any advantage over scaling alone for gingivitis. There were no significant differences between both groups for any of the gingivitis scores (table 23).

Pocket depth

Scaling caused a statistically significant improvement in pocket depth although the number of pockets involved were few.

This limited change in the pockets may have been due to the fact that majority of the pockets in the study groups were few.

OHE did not have any effect on the pocket depth and there are no significant differences between the "OHE" and "non OHE" groups in the changes that occurred in the pockets. Combining scaling with OHE did not have any advantage over scaling alone for pocket depth. No statistically significant differences occurred between the two groups (table 27).

Attachment

Scaling created a significant reduction in the attachment level ≥4 mm. The greatest improvement in pockets after scaling has been found to occur in the deep pockets (Philsrom et al, 1984). As stated above these pockets were few in these groups. OHE did not have a significant effect on the attachment level and no differences were observed between the "OHE" and "non OHE" groups. Combining scaling with OHE did not have any significant over scaling alone for the attachment level. No significant differences occurred between the two groups (table 31).

5.2 CONCLUSION

Scaling in this study produced some improvement on all the periodontal parameters except plaque. Its effect on the pocket depth and attachment level was limited in this study population. The main effect of scaling was on the subgingival calculus but

the supragingival calculus did not improve. The number of gingivitis free sites improved significantly after scaling. The OHE in this study was not effective in creating an improvement in plaque control in the relevant groups. Therefore, the groups that received OHE did not differ significantly from those that did not in any of the parameters.

Combining scaling with OHE did not have any advantage over scaling alone in this study. This was due to the failure in the OHE. The group that received scaling combined with OHE did not differ significantly from the scaling only group in any of the parameters.

Although in this study scaling was found to be effective in improving the periodontal status, it doubtful if this improvement would have been maintained over a long period of time since the levels of plaque in the scaled subjects did not improve. Indeed, supragingival calculus was found to have reformed within six months. It is possible that a deterioration also occurred in the other periodontal parameters, however, this was not detectable since there was only one post-treatment examination.

5.3 RECOMMENDATIONS

A study with more post-treatment examinations is required so that the changes that occur with time in the periodontal parameters after scaling can be determined. A deterioration on the supragingival calculus was observed to have occurred within the six months of this study. Some deterioration of the other

parameters was suspected. The deterioration was attributed to the poor plaque control in the subjects that recieved scaling. A study to determine the best methods of improving plaque control on a community basis is required. So far, no such study has been done in Kenya.

A longer study is required in order to determine whether scaling had any effect on the progression of periodontal disease. The six months of this study were too short for a significant change in the attachment level to occur.

It was interesting to observe that most of individuals in this study population had retained most of their teeth in a functional state despite the presence of untreated periodontal disease. Manji et al (1988), in their study on a Kenyan population found that despite having had no preventive periodontal treatment, majority of the population retained most of their teeth in a functional state over the age of sixty five years. If this is the case, then the benefits of scaling at the community level in Kenya, a country with an estimated life expectancy of 65 years at birth, are not be very clear. More studies on the progression of periodontal disease in Kenyans are therefore, required in order to determine treatment requirements for Kenya.

More practical objectives for periodontal therapy on a public health basis should be sort. The current objective of eliminating all signs of disease (WHO, 1986) is not practical and may not be necessary.

LIMITATIONS OF THE STUDY:

1. In this study the author did the treatments and examinations. This was because of a problem in obtaining a technically competent person to do these procedures. The suitable personnel that could have been used would either have been dental students or dentists working in the public sector. It was not possible to use dental students because the involvement and the amount of time required for the study was not compatible with their school curriculum. Employing a dentist would have been too expensive for the study.

However, the feeling when this study was conducted was that the length of time between the treatments and the final examination (6 months) and recall of the group in which an individual belonged would have been difficult at the final examination.

2. Another limitation of this study is that it was designed such that those that received OHE and those that did not receive OHE worked in the same work place. This meant that there was a possibility of OHE filtering to the groups that were not supposed to receive it (contamination). However, it was felt that separating these groups by using a different factory for each group may have made the groups incomparable in certain important baseline characteristics.

3. Having only one examination after treatment also created a limitation in the study. This is because the progression of effects of the treatment could not be determined. This study was initially designed to have two examinations after treatment, one three and another six months after. However, some of the workers were temporary laid off work due to a crisis in wheat shortages in the country around the time the 3 month examination was to be carried out. It was therefore not carried out and it was not possible to plan for another examination because of a limitation in the time available to carry out the research. This meant that it was not possible to tell from the study if the effects of scaling remained the same at the final examination as immediately after treatment or whether they deteriorated and if they deteriorated it was not possible to tell by how much this occurred.

4. Another limitation to the study related to the provision of OHE on a single occasion. While it was not possible to offer *more than one session in the present study due to financial* limitations, more than one session might be necessary to ensure adequate comprehension of instruction. Furthermore, long term control of periodontal disease requires sustained change in oral hygiene and therefore need for a more intensive health education programme.

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APPENDIX I

History Sheet

1. Name:_____

2. Age: _____

3. Tribe:_____

4. Residential Area:_____

5. Do you have any medical problem for which you are being treated e.g. a) diabetes
b) epilepsy Y/N ☐
c) any other (specify)

6. Do you brush your teeth? Y/N ☐

7. If you do, a) how many times a week? ☐☐☐
b) how many times per day? ☐☐☐

8. What type of brush do you use?
a) Manufactured toothbrush
b) Mswaki ☐
c) Any other (specify)

9. What class did you reach in school? _____

10. Do you smoke cigarettes? Y/N ☐

11. If you do, how many do you smoke per day? ☐☐☐

12. Do you drink alcohol? Y/N ☐

13. If you do:a) what type (beer, whisky, changaa) ☐
b) how many times a week?
c) how much at one sitting? ☐☐☐ ☐☐☐

14. Do you chew miraa? Y/N ☐

15. If you do, a) how often? _____
b) how much? (bundles) _____

16. Which toothpaste do you use? _____

17. Have you had any dental treatment? Y/N ☐

APPENDIX II:

ORAL HEALTH RESEARCH UNIT
Data Collection Form

Study ref: ☐☐☐☐ VIII HH/NO ☐☐☐☐

Case No: ☐☐☐☐

Place/School ☐ Urban 1 / Rural 2 ☐

Examiner: 1 / 2 / 3 ☐ Male 1 / Female 2 ☐

Age: ☐☐

Teeth Status:

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

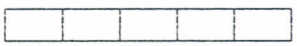
Dental Fluorosis:

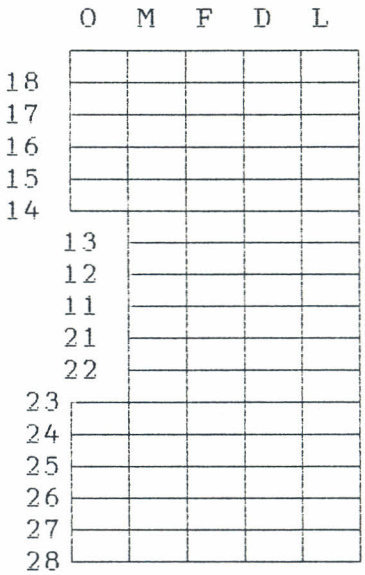
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

☐ Fci

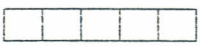
Surface Scores

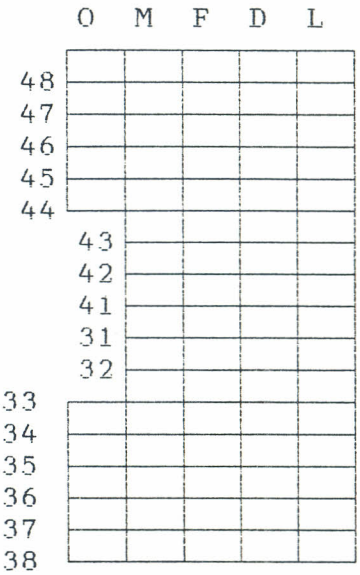
Case No: SEQ





Case No: SEQ





Case No: 1 | | | | Date: _____

	Plaque M F D L	Calculus M F D L	Gingiva M F D L	Attachment M F D L	Pocket M F D L
18					
17					
16					
15					
14					
13					
12					
11					
21					
22					
23					
24					
25					
26					
27					
28					

	M F D L	M F D L	M F D L	M F D L	M F D L
48					
47					
46					
45					
44					
43					
42					
41					
31					
32					
33					
34					
35					
36					
37					
38					

Mobility

18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	51	31	32	33	34	35	36	37	38

APPENDIX III: Guideline for Oral Hygiene Instructions

A. Causes of periodontal disease and caries

1. Poor oral hygiene resulting in plaque accumulation. This plaque contains bacteria which cause problems.
2. Frequent ingestion of sugary foods. This sugar together with bacteria from plaque lead to formation of caries.

B. Poor Oral Hygiene may be due to:

1. Not brushing at all
2. Infrequent brushing
3. Ineffective brushing.

C. Signs of dental diseases

- pain on eating or drinking
- bleeding gums
- swollen gums
- gum recession
- pus exudation from gums
- smelly mouth
- tooth mobility

D. To prevent dental diseases the following procedures should be followed:-

1. Brush teeth daily with a good toothbrush or mswaki,

2. Have a systematic way of brushing to ensure all teeth surfaces have been brushed e.g. brushing facial surfaces of the upper teeth followed by the lingual surfaces and the same procedure in the lower teeth, and finally occlusal surfaces up then down.
3. Use short horizontal strokes to ensure areas in between the teeth are cleaned.
4. Avoid brushing against the gingiva to avoid recession.
5. Calculus is formed from long standing plaque. It can only be removed professionally.

APPENDIX IV: INTRA-OBSERVER RELIABILITY

Tables 33 and 34: Agreement of the 1st and 2nd readings in the measurement of attachment level

BASELINE RESULTS

2nd reading

	0	1	2	3	4	5	6	7	8
0	39	9	3						
1	9	63	15	1					
2	1	10	46	5	1				
3		1	16	14	3				
4			2	3	3				
5				1		1	1		
6						2			
7					2	1			
8								1	

1st reading

Agreement of the first and second reading occurred in 66% of the sites. The first and second readings differed by ±1 mm in 28%, ±2 mm in 4% and ±3 mm in less than 1% of the sites.

FINAL RESULTS

2nd reading

	0	1	2	3	4	5	6	7	8
0	93	13							
1	5	15	3						
2	2	7	9	3					
3		3	0	11	2				
4			1	2	7	1			
5					4	2	1		
6							1		
7					2	1			
8								1	

1st reading

Agreement of the first and second readings occurred in 75% of the sites. The first and second readings disagreed by ±1 mm in 22% and ±2 mm in 6% of the sites

Tables 34 and 35 : Agreement of the 1st and 2nd readings in the measurement of pocket depth

BASELINE RESULTS

2nd reading

	0	1	2	3	4	5	6	7	8
0	2	3							
1	3	30	17						
2	1	7	73	14					
3		1	26	67	4				
4				3	7				
5					2	4			
6									
7							1	1	
8									

1st reading

Agreement of the first and second readings occurred in 69% of the sites. The first and second readings disagreed by ±1 mm in 11% and ±2 mm in less than 1% of the sites

FINAL RESULTS

2nd reading

	0	1	2	3	4	5	6	7	8
0									
1	21	10	2						
2	11	62	17						
3	1	1	9	43	1	1			
4				2	1				
5					1				
6									
7									
8									

1st reading

Agreement of the first and second readings occurred in 69% of the sites. The first and second readings disagreed by ±1 mm in 28%, ±2 mm in 2% and ±3 mm in less than 1% of the sites

Tables : Agreement of the 1st and 2nd readings in the measurement of calculus

BASELINE RESULTS

2nd reading

	0	1	2	3
0	88			
1		12		
2	9		22	1
3				

1st reading

There was agreement in the 1st and 2nd readings in 88% of the sites. Most of the disagreement occurred in the measurement of score 0 and score 2 calculus. Nine sites were measured to have score 2 calculus in the 1st reading and score 0 in the second reading. One site was read as score 2 calculus in the first reading and score 3 in the second reading.

FINAL RESULTS

2nd reading

	0	1	2	3
0	93		10	
1		7		
2	11		61	1
3				4

1st reading

There was agreement in the 1st and 2nd readings in 88% of the sites. Most of the disagreement occurred between score 0 and score 2 calculus.