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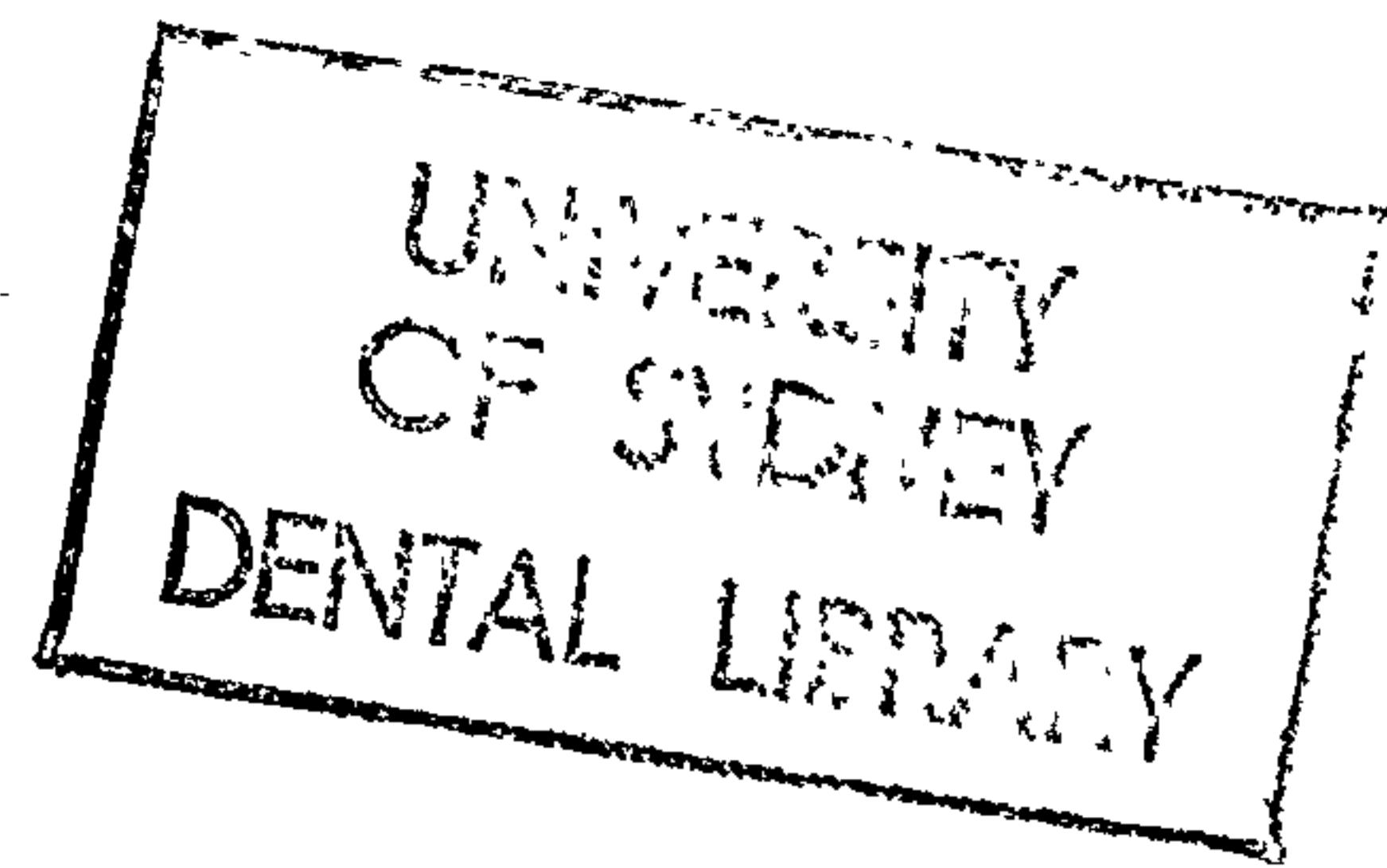
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ORAL HYGIENE METHODS

AND

PROCEDURES

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A Thesis submitted in partial
requirement for the
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J. SPENCER.

Eastern Command Personnel Depot

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INTRODUCTION

A philosophy has emerged, in the practice of dentistry, that the application of preventive measures to the control of oral disease does not need to accept failure as an important probability.

Dental research has provided useful tools and knowledge to prevent much oral disease. The proven effectiveness of anti-cariogenic compounds, better approaches to diagnosis, and the knowledge that a preventive approach to dental practice has been shown to be economically feasible in a number of private practices, give rise to a realisation that the dental profession must make a reappraisal of its aims and objectives, if the responsibilities of the profession are to be met. A dentist who considers the placement of a restoration, the extraction of a tooth, or the replacement of missing teeth, to be accomplishments or ends in themselves is not serving the total health of the patient, particularly in the light of present scientific knowledge.

The epidemiology of oral health has been detailed in the text by Felton¹ et al; the diseases considered being:

- (i) Dental caries
- (ii) Periodontal Disease
- (iii) Oral Cancer
- (iv) Dento facial deformities - Malocclusion
- (v) Dento facial deformities - Cleft Lip and Palate

The latter three conditions are not relevant to this thesis, as oral hygiene procedures do not effect their prevention or control.

Dental Caries and Periodontal Disease, the most common oral diseases of man will be those considered in this thesis.

DENTAL CARIES

In the chapter, Dental Caries, from the text book "The Epidemiology of Oral Health", Dunbar² describes the disease as "a chronic destructive disease of teeth which begins early in life, and, if not treated, generally results in the loss of affected teeth. Although caries has been present in human populations for thousands of years, massive and rampant destruction by caries is characteristic of modern times".

The epidemiological data reviewed reveals that the incidence of the disease can be related to such factors as different dietary patterns, socioeconomic gradients, cultural, racial and age influences. However, the overwhelming evidence is that the disease is known to all populations of the world, most prevalent in the so called developed countries, but with rising incidence elsewhere as living patterns of less "developed" communities change.

TABLE 1²

Table 1.11. DMF teeth per person aged 20-24 years, selected civilian groups

Groups	DMF per person
Ethiopia	0.5
Vietnam - Hill Tribesmen	0.7
Burma	1.0
Thailand	1.2
Vietnam - Vietnamese	1.7
Palestinian Refugees	2.0
Lebanon	4.0
Alaska - Primitive Eskimos	6.5
U.S. Negro	8.5
Ecuador	9.0
Chile	12.0
Colombia	13.0
Alaska - Urban Eskimos	13.5
Iceland	14.8
U.S. White	15.0
Alaska - Aleuts	18.0

Source: Russell (43,44), Dunbar and others (9), Interdepartmental Committee on Nutrition for National Defense (16 - 29).

Periodontal disease is an inexact term used to designate a variety of conditions of the supporting structures of the teeth. The finding of alveolar bone loss in the jaws of Egyptian mummies of 4000 years ago indicates that the disease has been known to man since the earliest civilisation. Periodontal disease is prevalent throughout the world. FIG 1³.

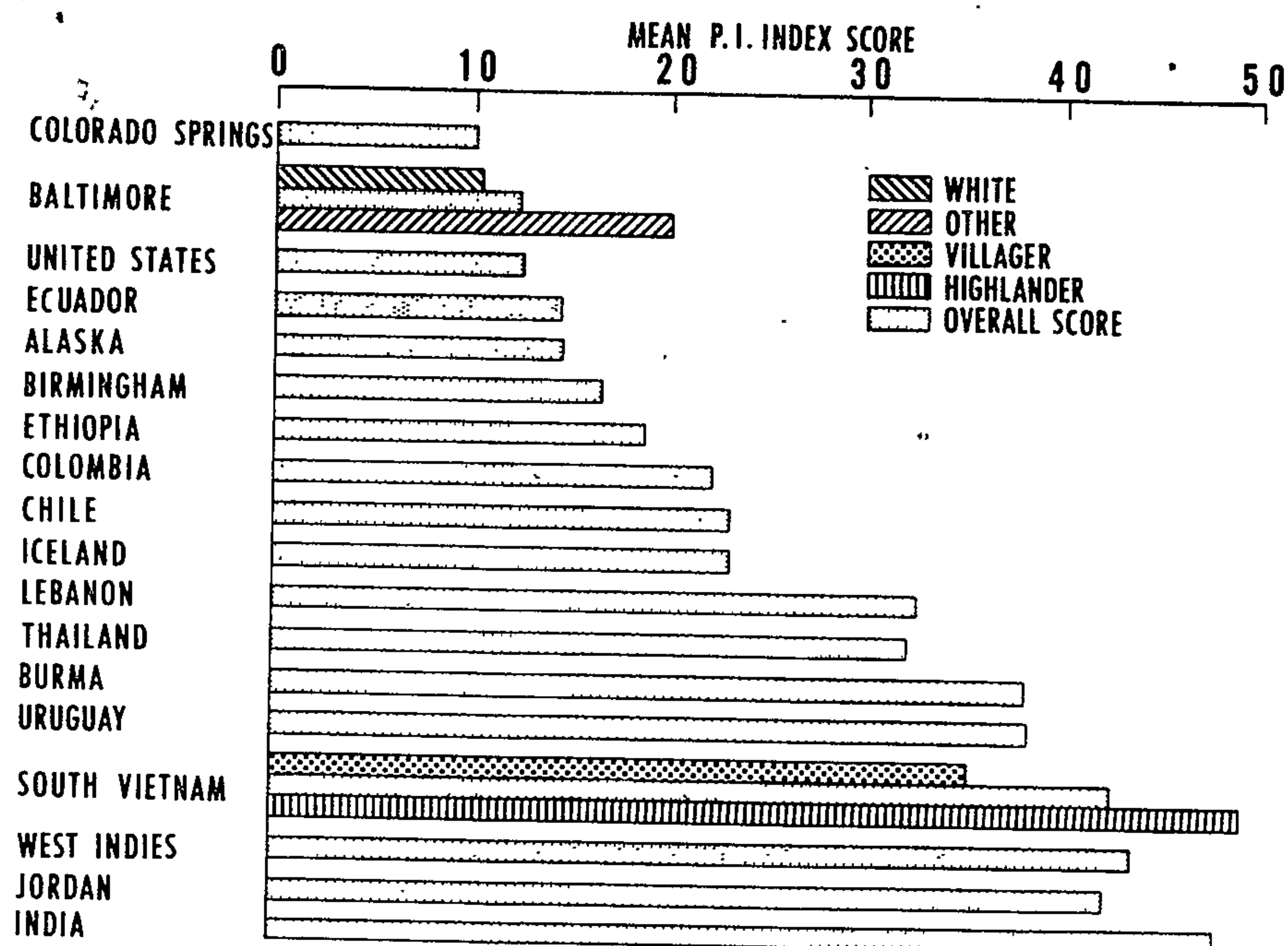


Fig. 2.3. Mean periodontal index scores based upon available worldwide data for ages 40-49 years.

Source: Interdepartmental Committee on Nutrition for National Defense Studies (30-44), Gupta (27), Russell and Ayers (83), Dunbar (17), and National Center for Health Statistics (68).

FIG 1 REF-3

It is a function of age, however, the potential for the advanced disease develops at an early age. Differences in the prevalence of the disease have been found to be associated with race,

Table 2.3. Percent tooth mortality or morbidity by cause for various studies cited

Country and year	Data source	Age range	Percent			Number patients	Number teeth
			Periodontal	Caries	Other		
U.S.-1929	Dental School Clinic(8)	10 and over	45.10 ^a	51.43 ^b	3.47	2723	13,909
U.S.-1944	Dental School Clinic(1)	1 and over	48.80	40.70	10.50	353	11,417
India-1951	Dental School Clinic(95)	1 and over	69.00	31.00	-	1992	2,840
U.S.-1954	Service Personnel (72)	15 and over	46.00	39.00	1.5	2000	-
U.S.-1958	Oral Surgery Spec. Practice(48)	all ages	20.20	39.70	40.10	2337	7,109
India-1958	Hospital Dental Clinic(58)	11 and over	66.30	26.70	7.0	4278	11,830
U.S.-1961	Hospital-Low Socioeconomic(3)	10 and over	36.00	38.30	-	805	2,411

Source: Brekhus (8), Allen (1), Subramanian (95), Pelton (72), Krogh (48), Mehta et al. (58), Andrews and Krogh (3).

^aRepresents percent loss for reasons of periodontoclasia and prosthetic correction.

^bRepresents percent loss for reasons of dental caries and pulp disease.

educational level, socioeconomic status and sex. Difficulties were found in finding a positive association with systemic disease and nutritional depletion as the manifestation in these cases is often overshadowed by the more direct causal factors present. All studies reviewed by McMillan and Wolff³ indicated a positive correlation between periodontal pathology as measured by the Periodontal Index of Russell⁴, age, and oral cleanliness as measured by the Oral Hygiene Index of Greene and Vermillion⁵.

Dental Caries and periodontal disease are the two main causes of tooth mortality in man^{6 7 8}; no population has been reported to be entirely free from either.

In 1954 Pelton⁹ et al reported on the tooth morbidity rates of a segment of the population of the United States, as a result of the findings of the study Pelton noted "Throughout the life span there is a sharp decline in the extent to which tooth losses are directly attributable to decay. Similarly, miscellaneous "other" causes which substantially effect tooth loss in early adult life become progressively less significant with advancing age. Periodontal disease stands out for all except the earliest two (15-24 and 25-34) adult age groups as the dominant reason for extraction."

Table 2 from Pelton³ et al gives a summary of various studies of the percentage tooth mortality rate by cause.

A philosophy of approach to the prevention and control of these diseases is suggested by Dunning¹⁰, The Future, Conquest

or Equilibrium. The following quotation is his summation: "Recent progress in the prevention and control of disease permits the conclusion that workers in the field of dental public health do not need to accept failure as an important probability. Complete conquest of dental disease is also a difficult outcome to imagine. Even with acute infectious diseases such as yellow fever and small pox, continuous preventive programmes and constant vigilance are needed, else the occasional cases of these diseases which still occur will erupt into epidemics. Chronic disease is even harder to "conquer" than acute disease. If, therefore, the reasoning presented here appears to point more to a state of equilibrium between dental disease and dental care than to the complete conquest of dental disease, the matter should cause no surprise or discouragement. Human life is always more of a equilibrium than the finished fight. Equilibrium implies the challenge to new endeavours and also a satisfying proportion of success. It also implies control, a concept almost as satisfying as complete success.

In the meanwhile, the chance to make dental caries and periodontal disease as rare as smallpox does exist. Scientific advances may produce highly efficient preventive measures not incompatible with modern cultures, health education may secure virtually universal utilisation of these measures, and long range changes in the diseases themselves or inhuman resistance to them may reverse the upward trends of recent centuries. Without all three, the likelihood of full success is small".

Oral hygiene will be shown to play a significant role in the control if not complete prevention of dental caries and periodontal disease. In this thesis the available literature on the value of oral hygiene agents and procedures available to the dentist, the dental auxiliary, and the individual will be critically reviewed.

SECTION A
DEPOSITS ON TEETH

DEPOSITS ON TEETH

Although it is clinically apparent and generally accepted that the removal of tooth accumulated materials¹¹ can greatly lessen if not entirely prevent dental disease, much still has to be learned about the specific nature of these deposits and their relationship to dental caries and periodontal disease.

The identification and classification of these materials was necessary as a prelude to studies as to their effect on oral tissues.

In 1963, Dawes, Jenkins and Tonge¹² reviewed the literature on the nomenclature of the integuments of the enamel surface of teeth. They distinguished four types of acquired deposits.

1. Acquired pellicle
2. Dental plaque
3. Dental calculus
4. Food debris

A later review by Schwartz and Massler¹¹ proposed that a fifth, Materia Alba, be added, based on a report by a World Health Organisation Expert Committee in 1961¹³.

ACQUIRED PELLICLE

Pellicle is derived from the latin word pellicula, meaning a thin skin or film.

The presence of an acquired pellicle was first reported by Manly in 1943¹⁴. He observed a recurrent, brown structureless, bacteria free deposit on the teeth of patients who used a non abrasive (liquid) dentifrice. The acquired pellicle, according to Manly,

resembled the primary embryonic cuticle in its structure and freedom from bacteria, except that it would recur after removal. Turner¹⁵ found that the acquired pellicle was different from the embryonic cuticle histochemically.

Pellicles of salivary origin may be formed within minutes on cleaned tooth surfaces. The films are thin, clear, and almost invisible; with time they change to a thicker, more readily distinguishable pigmented layer. Manly¹⁴ reported that the acquired pellicle required one week to form. The thickness varies from 0.1 to 0.8μ (McDougall¹⁶, Leach and Saxon¹⁷). Its distribution has been noted throughout the mouth, it forms preferentially on the gingival one third of the labial surface of upper anterior teeth. (Vallotton)¹⁸.

The natural colour of acquired pellicle may be translucent, brown or grey (Manly¹⁴, Vallotton¹⁸). The source of pigments which cause a progressive discolouration have not been determined.

The acquired pellicle forms in association with structures other than enamel. It has been found on the surface of artificial dentures, (Millin and Smith)¹⁹ and on the surface of an extracted tooth placed back in the mouth on an artificial denture (Turner)¹⁵.

Meckel²⁰ was the first to show that acquired pellicle was a product of saliva. He worked with (i) pellicles floated off freshly extracted teeth, (ii) pellicles formed on the enamel of teeth worn in partial dentures, (iii) pellicles formed on enamel, incubated in saliva, (iv) dried salivary films. He found that all four organic films had almost identical staining properties indicating they were all of salivary origin.

Experiments have shown that bacteria are not necessary for the formation of acquired pellicle. Meckel²⁰ formed pellicle in vitro despite the addition of antibiotics to the incubated saliva.

Acquired pellicle FIG 2 has been classified into three categories by Meckel²⁰; two on the enamel surface, the distinction being that one was transparent and the other had taken on an intrinsic stain and was called stained pellicle. The third type was a subsurface pellicle which penetrated the surface layer of slightly damaged enamel.

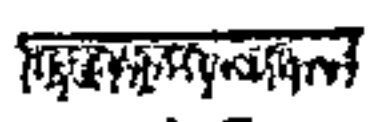
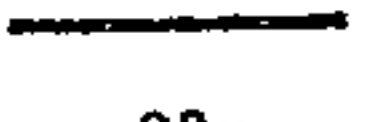
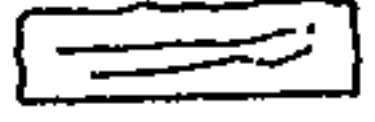
	PRIMARY CUTICLE (Nasmyth Membrane)	STRUCTURES ACQUIRED AFTER ERUPTION			
		OUTCLES		STAINED PELLICLE	PLAQUE
		SUBSURFACE	SURFACE		
APPROXIMATE THICKNESS	 1-5 μ	 1-3 μ	 0.2 μ	 1-10 μ	 5-200 μ
STAINING WITH BASIC FUCHSIN	CELLS STAIN RED	?	PURPLISH RED	LITTLE OR NONE NATURALLY BROWNISH	BRIGHT RED
CALCIFICATION	OBSERVED IN CELLS ONLY	?	?	YES	YES

FIG. 1. Diagrammatic representation of organic films encountered with enamel surfaces.

FIG 2 REF-20

Meckel²⁰ was not sure if the stained pellicle was only a stained and thicker variety of the other two acquired pellicles.

Surface pellicles could usually be removed with abrasives (Manly¹⁴, McDougall²¹, Meckel²⁰), but were not removed by brushing teeth with a moistened brush alone. (Manly¹⁴, Vallotton¹⁸). Sub surface pellicle required the use of a two percent solution of hydrochloric acid for removal (Meckel²⁰)

The acquired pellicle has been designated a protective and a destructive potential for tooth enamel. Meckel²⁰ reported that

the subsurface type may serve as a protective mechanism for the enamel, capable of plugging voids created by the dissolution of enamel crystallites and thereby rendering the enamel more resistant to dental caries. However, the acquired pellicle may be associated with the formation of bacterial plaque by acting as a nidus for bacteria. (Meckel²⁰ McDougall²¹ Vallotten¹⁸.)

DENTAL PLAQUE.

The use of several synonyms and definitions has led to confusion in the literature as to what constitutes a dental plaque. Dawes¹² et al listed plaque, materia alba and microbacterial film. Various definitions have been offered by authors: Mandell²² McDougal¹⁶, Winkler and Dirks²³. A composite of these definitions presented by Schwartz and Massler¹¹ is as follows:

"Dental plaque is a dense microbial layer consisting of a coherent mass of filamentous, rod-like and coccoidal micro-organisms embedded in an intermicrobial matrix which accumulates on the tooth surface. In later stages, it has a definite microscopic architecture characterised in histologic sections by a fibrillogranular meshwork with a parallel arrangement (pallisading) of the filamentous organisms. Dental plaque is a product of microbial growth, originating in areas which are not cleaned or are not cleanable. It may be a precursor of dental calculus and dental caries".

Bacterial plaque was first described in 1897 by J. Leon Williams. Initially, the emphasis in experimental studies was directed to the cariogenic potential. Later the effects of plaque on

the adjacent soft tissues received attention, so that today the metabolism of plaque is considered by Mandell²² to be bi-directional: i.e. outward toward the soft tissues (to produce gingivitis), as well as inward toward the tooth surface (to produce dental caries).

The location of plaque on teeth is variable from mouth to mouth, but seems to have a predilection for the gingival margins, cracks in the enamel, and the interproximal and other areas not functionally cleansed. (Bjorn and Carlsson)²⁴. Bacterial plaque appears regularly on the surface of dental calculus (Mandel).²²

Bacterial plaque contains little if any food or epithelial debris (McDougall¹⁶). It may be readily removed with abrasives (McDougall)²¹ but was not flushed off the tooth with a stream of water (Mandel)²². These factors are important in distinguishing bacterial plaque from the bacteria free acquired pellicle as well as from food debris and materia alba.

DENTAL CALCULUS.

The word "calculus" was derived from the latin word for a pebble or stone. Tartar, a once common synonym for the mineralised accumulations on teeth, is taken from the latin, tartarum, meaning the accumulated sediment or crust on a wine cask. Tartar is therefore a more descriptive term than calculus but has lost favour in common usage.

Dental calculus results from the mineralisation of dental plaque, reported by Mandel, Levy and Wasserman²⁵. In that study

demineralised calculus, morphologically, was found to resemble dental plaque .

Mineralised deposits were found occurring in the mouths of germ free animals by Baer and Newton²⁶. These deposits appeared to be calcium salts deposited into a bacteria-free organic salivary precipitate, they form rapidly and are chalky and easily crumbled. This indicates that although bacteria are usually present, they are not essential for the formation of calcified dental deposits.

In its mature form, dental calculus, consists of an organic matrix impregnated with 70-90 percent inorganic salts. The inorganic component increases with age, but regardless of age consists primarily of calcium and phosphate. (Theilade and Schroder)²⁷

Schwartz and Massler¹¹ reported in their review that: "recent evidence indicates that the inorganic salts of subgingival calculus may be, as Black (1882) postulated, derived from serum (serum calculus), while those of supragingival calculus are derived from saliva (salivary calculus)¹¹

FOOD DEBRIS

Food debris is merely food retained in the mouth. Unless impacted between the teeth, it is usually removed by the action of the oral musculature and saliva or by gentle rinsing. (Dawes et al)¹².

The frequency with which discernable food debris occurs in the mouth and its role in the formation of other types of deposits on teeth has not been clearly demonstrated. Food debris has often been called materia alba, Dawes, Jenkins and Tonge¹² proposed that it be

known as food debris even though it will be contaminated with some bacteria.

MATERIA ALBA

Materia alba is latin for white matter. Although Dawes et al¹² did not recognise it as a clinical entity, it is a specific type of tooth accumulated material different from both dental plaque and food debris (World Health Organisation, 1961)¹³.

It is a soft, white mixture of salivary proteins, desquamated epithelial cells and disintegrating leukocytes which adheres loosely to the surfaces of the teeth, dental plaque or the gingiva.

Although materia alba consists in a large part of bacteria, it does not possess a specific architecture. Also in contrast to plaque it can usually be flushed off the teeth with a water spray, (Mandel)²².

SUMMARY

A classification of the five categories of deposits on teeth:

- (i.) Acquired (salivary) pellicle
- (ii) Dental (bacterial) plaque
- (iii) Dental calculus (mineralised plaque)
- (iv) Food debris
- (v) Materia alba

has been established.

In this thesis this classification will be used when review-

ing the literature on methods and procedures of removing these accumulated materials on teeth as preventive measures of dental disease.

SECTION B

Oral Hygiene Procedures: For the prevention
and control of dental caries.

DENTAL CARIESHISTORICAL.

The results of dental caries have been observed in archeological findings from civilisations dating back to earliest times. Ancient petrified skulls furnish ample evidence of cavities in teeth and gum abscesses. Fourteen per cent of the skulls of Danish Stone Age had carious teeth. Among the earliest Egyptians, caries was comparatively rare, but became more prevalent as their civilisation advanced. During the reign of the Ptolmeys, and later at the time of the Byzantine Empire, it was almost as common as it is today. Tombs found in the Gizeh pyramid produced nearly five hundred skeletons whose skulls showed evidence of dental decay.

Translations from an ancient Egyptian manuscript, the Ebers Papyrus, dated thirty seven centuries before Christ revealed constant references to dental maladies; "blisters of the gums and gnawing teeth".

The Chinese wrote extensively on dental disease as long ago as 3000 BC, references being made to twenty puncture points in various parts of the body for the cure of toothache.

Archeological evidence would support the statement by Bremner²⁸ in The Story of Dentistry that "Decay of human teeth from ancient times has been found in so many places that it is legitimate to doubt whether there was ever an epoch when the human species was not cursed with toothache".

ETIOLOGY OF DENTAL CARIES

Dental caries is an infectious disease affecting the calcified tissues of teeth. It is characterised by a series of complex chemical and microbiological reactions which result in the destruction of the tooth. It is almost universally agreed that this destruction, which progresses from the surface of the tooth to the interior, results from chemical substances produced in the immediate tooth environment.

According to Katz²⁹ in his chapter from Bernier and Muhler; "Enamel and Dental Caries", there are two entities to be considered in the etiology of dental caries from a preventive dentistry viewpoint:

- (i) the tooth, which is destroyed
- (ii) the tooth environment, where the destructive agents are formed.

Tooth substance must dissolve for caries to result: consequently, the solubility properties become important to an understanding of the carious process. Gray³⁶ stated: "In the simplest analysis, dental caries can best be described as a morphologically selective dissolution of hard dental tissues, enamel, dentin and cementum in the liquid phases in which they are bathed. Enamel is usually the most important site of caries attack!"

The enamel surface is rarely bathed directly by the salivary fluids. Depending on the particular tooth, the surface, and the area on that surface considered, the enamel surface may be covered by a

film of salivary origin (acquired pellicle), a more or less actively metabolising assemblage of micro organisms (plaque) or a calcified deposit (calculus).

It is now generally accepted that plaque is the arch enemy of teeth. Plaque enables large numbers of bacteria to be concentrated at various sites on the tooth surface, and prevents the tissue damaging products elaborated by many of the bacteria from being readily diluted or dissipated. When sucrose or other soluble sugars are added as substrate the resultant fall in PH to the point at which enamel dissolution occurs is considered by many investigators to be the initial step in dental caries (Mandel)²².

The composition and physical properties of plaque are affected by such factors as the composition of saliva, nature of the diet, position in the mouth, age of the deposit, and the bacterial population of the individual. (Critchley et al)³³.

A description of dental plaque has been given in the section Deposits on Teeth.

Studies in animals have shown that a sucrose diet is more cariogenic than a similar diet in which sucrose has been replaced by other fermentable carbohydrates.³⁰⁻³².

Carlsson and Egelberg³⁴ demonstrated, in man, that variations in the composition of the diet markedly affected both the amount and type of plaque formed. Patients on a soft protein-fat diet developed a thin structureless plaque after a few days with little increase in the amount after a week. When this diet was supplemented with frequent

portions of glucose there was no appreciable difference in the amount or appearance of the plaque. However, if sucrose was added at frequent intervals there was a dramatic change in the appearance of the plaque. It grew considerably and became a voluminous turgid mass. Examination showed colonies of bacteria, resembling those formed in vitro by some strains of streptococcus salivarius surrounded by a substance thought to be extracellular polysaccharide.

Much evidence has now been accumulated which shows the important role of streptococci in the initiation of dental caries. Many streptococci have the characteristics to fulfil this role:

1. They produce large amounts of gummy substances, known as extracellular polysaccharides, when grown in the presence of sucrose. These extracellular polysaccharides have been found in plaque matrix, and because of their adhesive properties, are believed to provide the means by which bacteria are held together in proximity to the tooth surface.
2. They ferment a wide variety of carbohydrates producing acids with a final PH below 4.5.
3. They can build up extracellular stores of polysaccharides which they can use at a later stage to produce acid if outside sources of carbohydrate become depleted or unavailable³⁵.

Dental caries, whether manifested by a single slowly developing lesion or by rapid destruction of multiple tooth surfaces, is initiated and sustained by acid demineralisation of the inorganic content of susceptible tooth structure, FIG 3.



FIG 3

Enamel decalcification due to retention of dental plaque. Also evident are gingival changes (gingivitis) around the teeth with areas of decalcification.

The acids are formed as the result of bacterial enzyme fermentation of food debris render conditions conducive to much activity within the oral cavity. Dental plaque has been shown to be the prime factor in producing these conditions, therefore, its removal and prevention of recurrence must play a vital role in the complex procedures of the prevention of dental caries²⁹.

A regimen of oral hygiene procedures is available to the dentist and the individual for plaque control. The phrase coined by

Leon Williams in 1887, "A clean tooth never decays", should not be disregarded in the light of present knowledge.

DISCLOSING AGENTS

The increased use of disclosing agents is considered by many therapists to be the most important single advance in oral hygiene methodology for many years. Although disclosing agents are not new to dentistry, only recently have they received wide acceptance.

Despite their obvious advantage of vividly identifying the presence and precise location of bacterial plaque, solutions of basic fuchsin, the original dye used, were rejected largely because of the caution necessary in their application. These solutions stained everything with which they came into contact, ruining towels, clothing and staining surgery and bathroom fittings. Another factor inhibiting the use of basic fuchsin was the possible carcinogenic linkage. Workers in the Aniline dye industry were found to have a higher incidence of carcinoma of the bladder than groups from other industries. Although it was exceedingly doubtful that the amounts of basic fuchsin used in disclosing solutions in dentistry could ever have had such effects, the suspicion aroused enough concern to limit the use of basic fuchsin (Goldman and Cohen)³⁷.

These objections to disclosing agents were overcome by the work of Arnim³⁸, the results of whose study were published in 1963. Firstly, Arnim³⁸, in association with Webber, developed a disclosing wafer consisting of a water soluble vegetable dye (F D C red No. 3 - erythrosin) compounded into a flavoured tablet. The solution created

when the wafer is chewed does not colour the teeth or restorations, but is fairly specific for bacterial accumulations.

The specifications for the disclosing wafer established by Arnim and Webber were: "The seven grain tablet should be smooth, dust free, clean and palatable. It is to be packed in a moisture proof plastic envelope, one wafer to a pocket. The active ingredient should stain the microorganisms of the mouth a pleasing shade of red. They should dissolve readily when chewed and swished around the mouth for about one half minute. The resultant solution should be harmless and non toxic. The dye must not stain the fillings of teeth. The stain on lips cloth and furniture should be easily removed. Stain remaining in the mouth should dissolve in saliva and disappear by the following day."

The second phase of Arnim's³⁸ study was to develop a technique for measuring tooth cleanliness prior to and after oral hygiene procedures. A combination of photographs, mirror examination and the use of dental floss were used to record the stained areas on teeth, the outline of the staining was traced on to dental record cards. Following the initial staining the teeth were cleaned with the method being studied at the time and a second set of tracings made. Comparable measurements were obtained using the width of the central incisors as a reference and enlargement to four times this measurement made to adjust for differences in camera angles. A planimeter was used to

obtain the stained tooth area and the total tooth surface area, and the percentage surface area covered by bacteria calculated. FIG 4 presents a tracing taken during one of the studies.

The technique was applied to test the cleansing effect of (a) fibrous foodstuffs (b) personal oral hygiene methods (c) mouth-washes. The results of the studies showed shortfalls in all cases to the extent that Arnim³⁸ was to comment, "We preach preventive dentistry and recommend oral hygiene as our most effective weapon against dental disease. At the same time, the methods we usually recommend only partly clean occlusal and labial surfaces while they leave approximal and lingual surfaces relatively untouched. Most important, no method is recommended generally whereby the patient can test for himself the effect of his own personal oral hygiene practices".

Today the use of disclosing agents is an accepted practice. The dentist uses them regularly to locate those zones where treatment methods have failed to eradicate the microorganism adequately.

Disclosing agents are used to show patients the colonisation sites, the volume present and their significance in relation to dental disease, FIG 5. The patient is instructed to test the effectiveness of his personal oral hygiene at home, saving time in the dental surgery and achieving the purpose faster as the patient learns to correct his own mistakes.

CHART II
TRACINGS OF TEETH OF PATIENT J. S.
 THE EFFECT OF CARBAMIDE (UREA) PEROXIDE IN ANHYDROUS GLYCEROL
 ON MICROCOSMS BEFORE AND AFTER PROPHYLAXIS.

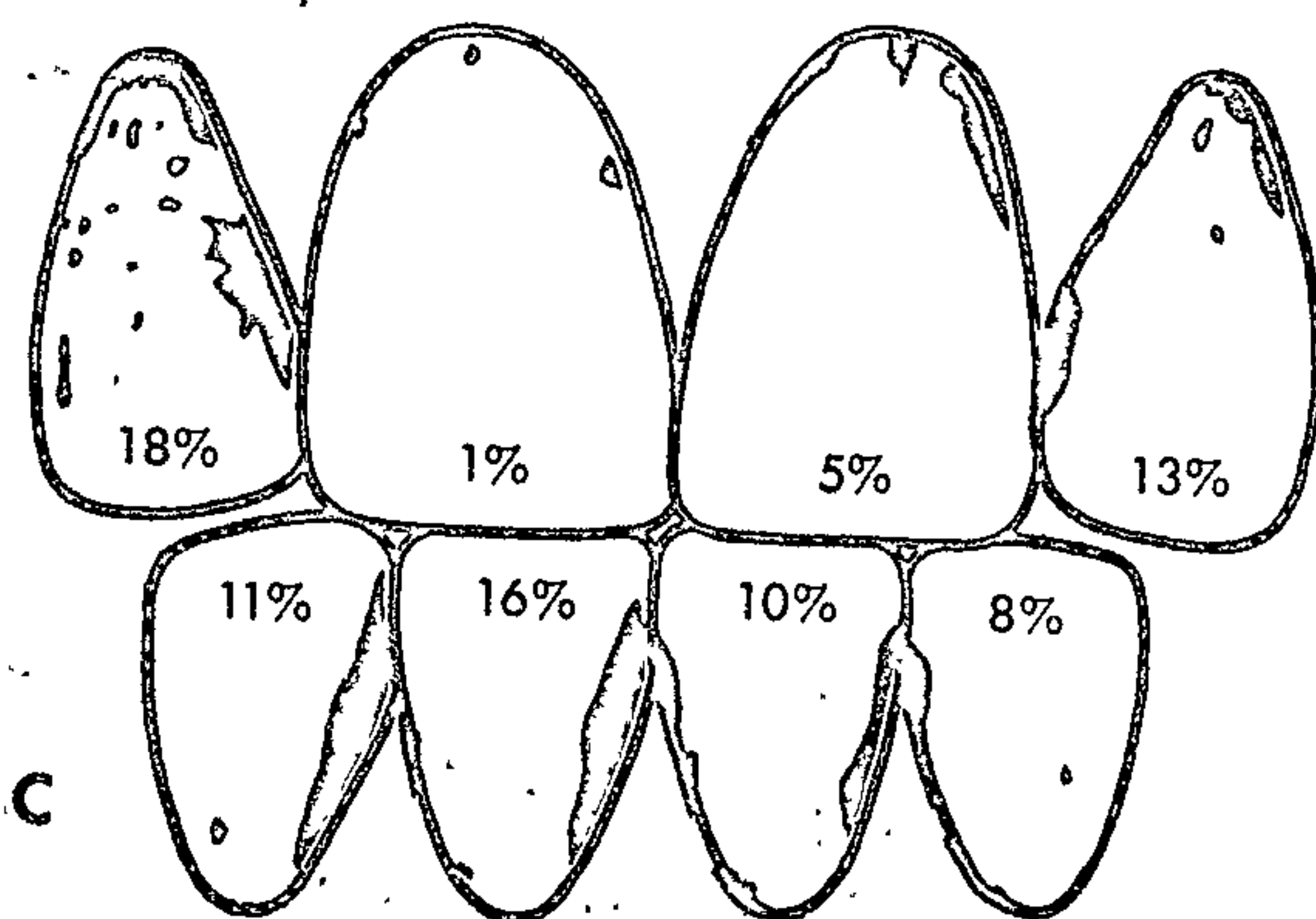
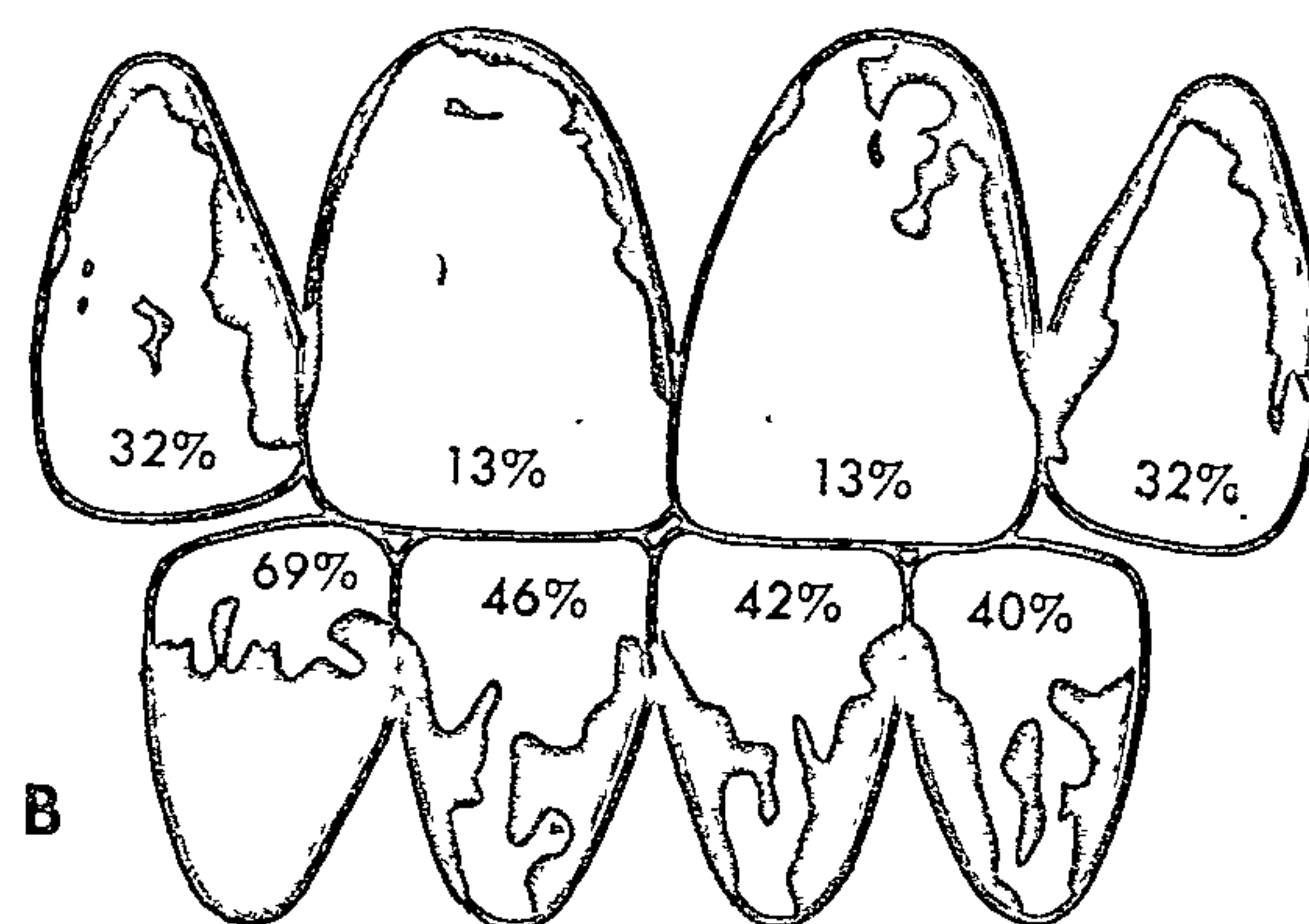
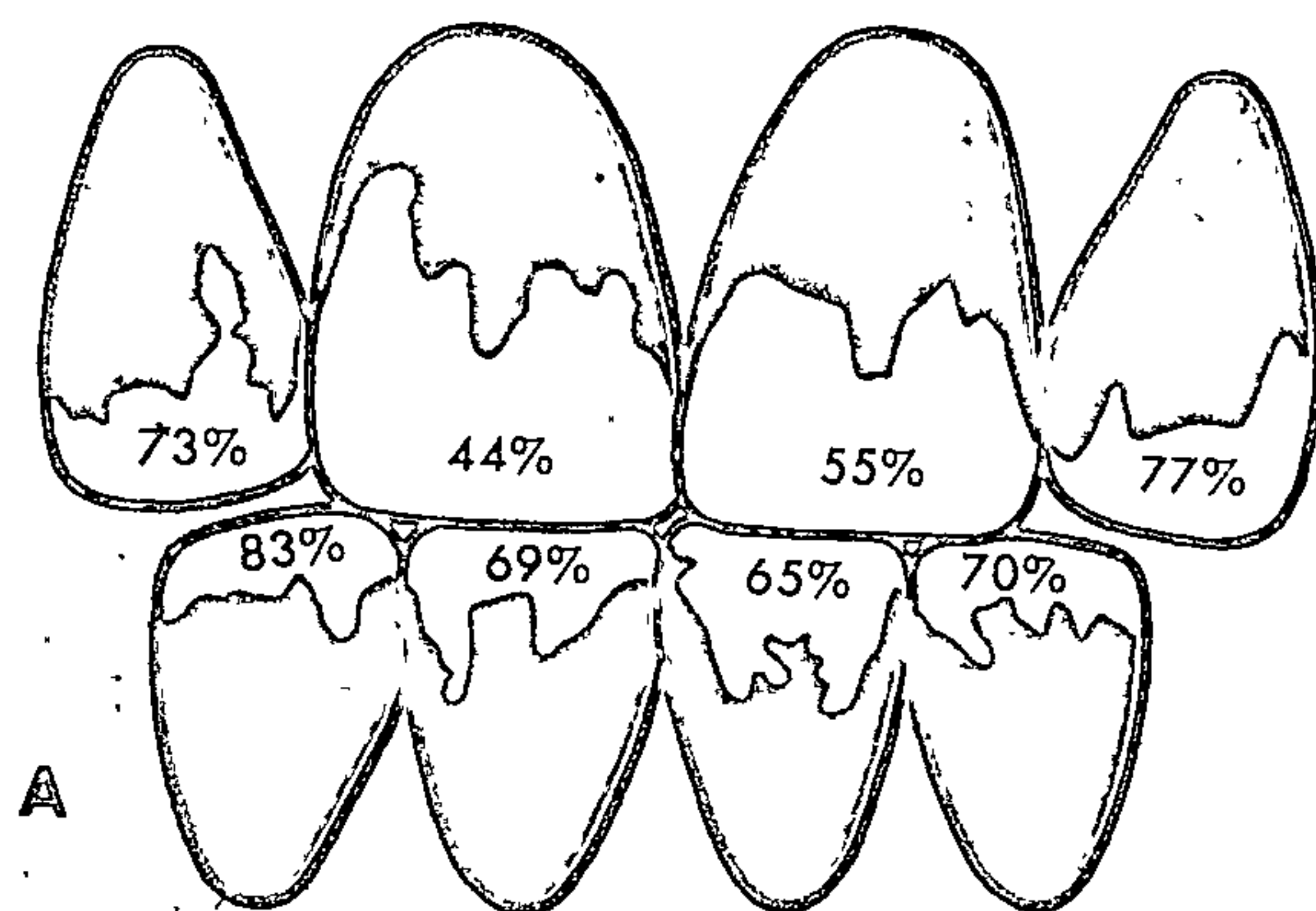


TABLE III
 Planimeter Measurements of Teeth in Chart II
 Effect of Carbamide (urea) Peroxide in Anhydrous Glycerol on Microcosms

	Percentage of Labial Surface Covered by Microcosm							
	Maxillary				Mandibular			
	2	1	1	2	2	1	1	2
A. 7 days growth of Microcosm, no P. O. H.	73	44	55	77	83	69	65	70
B. Carbamide (urea) peroxide for 7 days	32	13	13	32	69	46	42	40
C. 7 days growth after prophylaxis carbamide (urea) peroxide sole hygienic agent	18	1	5	13	11	16	10	8

		LEFT								RIGHT									
		8	7	6	5 e	4 d	3 c	2 b	1 a	Sub Total	1 a	2 b	3 c	4 d	5 e	6	7	8	Sub Total
Upper	Facial																		
	Lingual																		
Lower	Facial																		
	Lingual																		

Total

Plaque Scoring

0 No plaque

1 Gingival Third

2 Into Middle Third

3 More than two thirds

Figure 8. A diagram showing a simple form of Plaque Score Card together with a method of scoring the amount of plaque present on the facial and lingual surfaces of the upper and lower teeth.

Safe and effective disclosing agents are available in tablet and in the form of palatable rinses.

Disclosing agents enable deposits of dental plaque to be located visibly on the tooth surface, enabling the bacterical film which is normally unseen to be cleaned. Dental plaque has been identified as a prime cause of dental caries, hence disclosing agents are an important adjunct to prevention.

TOOTHBRUSHING

MANUAL TOOTHBRUSHES:

HISTORICAL: The toothbrush is a mechanical device to aid in the removal of soft accumulations from the surfaces of the teeth. Man has used some form of brush as an adjunct to oral cleanliness for many years. There are references to the use of splayed twigs as early as 4000 BC, a form of tooth cleansing still practiced by primitive people in the form of chew sticks.

The first bristled tooth brush was manufactured in China in 1500 AD (Bruxodent Manual)³⁹. Tooth brushes were known in Europe during the seventeenth century, but were expensive novelties for the rich, described as being bound in gold and silverware.

A toothbrush resembling the modern article was made in England in 1780 (Addis)⁴⁰. This consisted of a bone handle with natural bristles drawn into holes bored in the head, secured by wires. This type of brush, manufactured by William Addis, was eventually taken into general use. The first American patent for a toothbrush was that of H. N. Wadsworth in 1857.

A radical change in the method of manufacture came early in the twentieth century with the invention of a plastic material, celluloid. The use of this material reduced the cost as it replaced the expensive ivory and tortoiseshell previously used. The adoption of quantity production by fast machines, after World War 1, further reduced cost, and the toothbrush became available to the working classes.

The early development of the toothbrush was not based on any

organised scientific basis. So much variety in design existed that, Talbot in 1910, remarked on the untenable situation, "the market was full of all sizes and shapes of handles and bristles bought regardless of their adaptability to the mouth and teeth".⁴¹

In 1919, a committee of the American Academy of Periodontology prepared a report setting out the specifications for a tooth brush. This action focussed attention on the inadequacy of the existing brushes. Subsequent studies by Kauffman, Stillman, and Hirshfeld⁴¹ demonstrated that few available toothbrushes conformed to a scientific standard compatible with their role. These studies and the development of a rationale for the effective cleaning of teeth have resulted in the present preference for two and three row brushes with small head and tufts of equal length.

The next significant development came about 1939, with the introduction of synthetic materials, nylon replaced natural bristle, and acetate, methacrylate, and butrate replaced celluloid for the handles. These materials, suited for mass production, have enabled a satisfactory toothbrush to be marketed at a price which is within the reach of all classes of people.

DEFINITION: Kauffman⁴² defines the toothbrush as an "artificial hygienic device used in conjunction with a dentifrice to brush the teeth, consisting usually of a handle and clusters of bristles so arranged as to exert the most beneficial action possible without causing injury to the hard structures or adjacent soft tissues.

SPECIFICATIONS AND REQUIREMENTS. The Council on Dental Therapeutics of the American Dental Association⁴³ described the requirements: "The toothbrush must conform to the individual requirements in shape, and texture, and be easily and efficiently manipulated, readily cleaned and aerated, impervious to moisture, durable and inexpensive. Prime functional properties are flexibility, elasticity and stiffness in the bristles, strength, rigidity and lightness in the stock. Design is arbitrary to meet the requirements of utility, efficiency, and cleanliness. Limitations in size and shape are dictated by the curvilinear alignment of the teeth, and the presence of anatomic characteristics and structures that restrict the concavity of the lingual aspect of the arch, the mandibular ramus, the cheeks and the lips. For general adult use, the straight trimmed, straight handled brush with comparatively small (1" to 1½" long, 3/16" to 3/8" wide) brushing surface probably combines as successfully as any other the advantages of easy manipulation, efficiency, cleansibility and structural simplicity."

A study by Fanning and Henning⁴⁴ considered tooth brush design and arrived at details of a brush suitable for children and adults. The recommended brush had the following specifications:

Hardness: A soft brush has superior cleansing qualities and is less liable to cause traumatic injury to the tooth and gums.

Size: The specifications given by Bass⁴⁵ were considered

satisfactory.

Child brush:

1. Plain straight handle design about 5" in length, 7/16" wide, 8 rows of bristles, 6 tufts to a row, evenly spaced.
2. High quality nylon bristles, about 80 per tuft, .005" in diameter, flat trim, finished to 11/32" in length.
3. Ends of the bristles ground and finished to hemispherical shape or at least enough to eliminate all sharp points and rough edges.

Adult brush: A similar brush of increased size should have an overall length of about 6", 0.007" bristles, finished to 13/32" in length.

Emphasis was made of the softness of the bristle and the flatness of trim. When a flat trimmed brush is used all the bristles become effective. This is especially so with a soft brush since the bristles, having a smaller diameter, bend without injuring the tissues of the gingival crevice, although they have sufficient strength to dislodge soft material there.

An illustration of toothbrushes of varying profiles is given in Fig 5³⁹ with a comparative explanation in Table 3³⁹.

It is recognised that personal preferences and differences in manipulative skill may render toothbrushes of widely different designs satisfactory in individual cases. However, the concensus of opinion favours the small, soft, multitufted, flat profile brush recommended

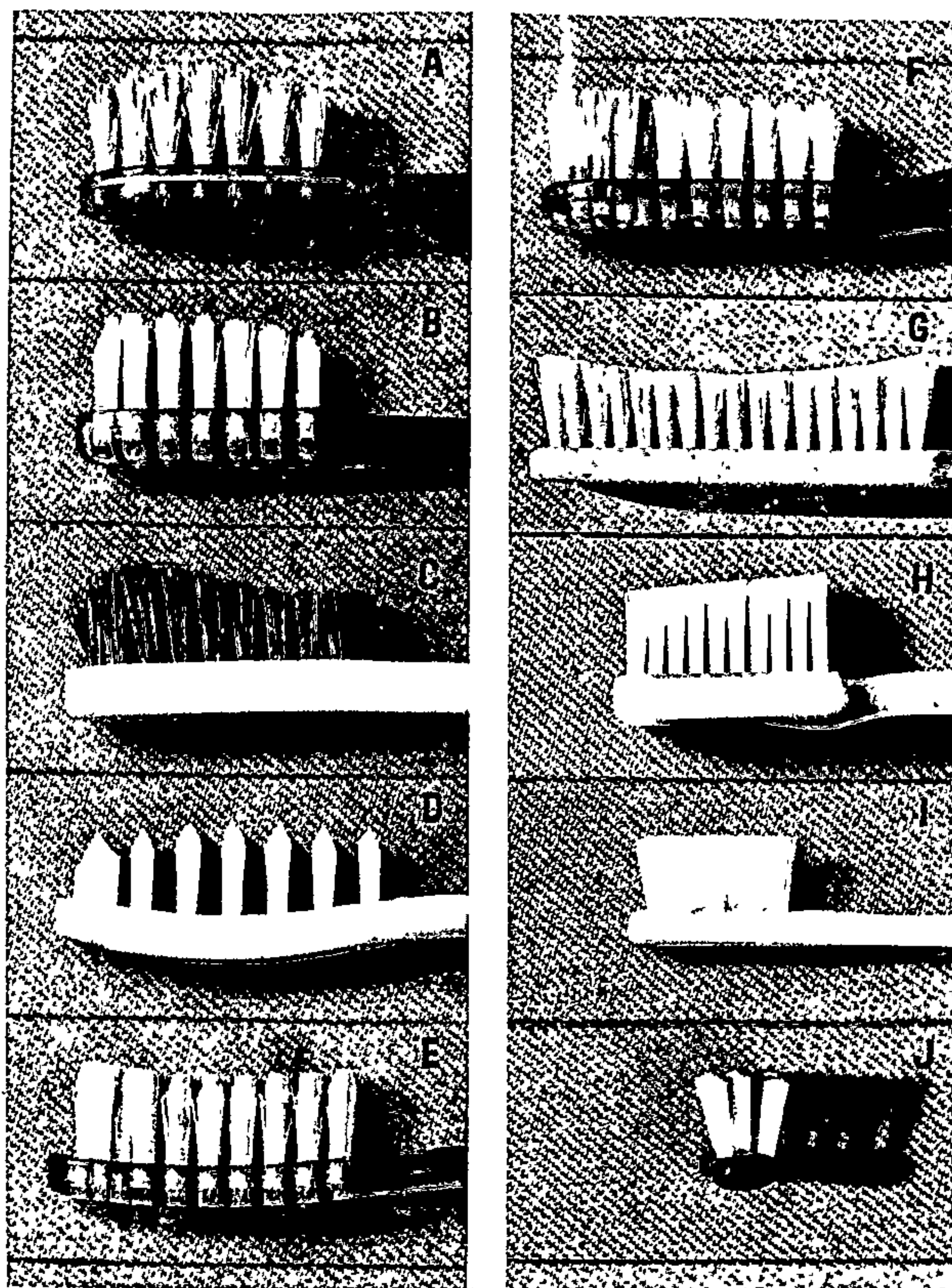


FIG 5 REF-39

TABLE III
Comparison and explanation ; Figures A-J.

	<i>Profile</i>	<i>Rigidity</i>	<i>Occlusal brushing</i>	<i>Interdental brushing</i>	<i>Lingual brushing</i>	<i>Last molar brushing</i>
A	Convex	Variable	Non satisfactory	Unefficient	Possible, except frontal region	Impossible
B	Convex		Incomplete	Unefficient	Possible, except frontal region	Impossible
C	Flat convex		Relatively good	Satisfactory	Very difficult	Relatively good
D	Flat, concave		Mediocre	Easy (cuspid-bicuspid area)	Very difficult	Very difficult
E	Concave		Incomplete	Impossible	Impossible	Impossible
F	Flat		Relatively good, but size provokes long strokes	Impossible	Impossible	Impossible
G	Concave		Difficult	Impossible	Impossible	Impossible
H	Flat		Good	Difficult	Easy except for frontal area	Difficult
I	Flat		Good	Easy	Very easy	Easy
J	Flat		Good	Easy	Very easy	Easy

TABLE 3 REF-39

by Fanning and Henning⁴⁴. This design is in agreement with the specifications of the American Dental Association⁴³.

TOOTHBRUSHING TECHNIQUES

Many different techniques have been devised and recommended for keeping the teeth clean. The most effective and simplest for the individual requires the use of a toothbrush Steele⁵⁵. Methods described in the chapter by Wagner⁵⁵ are as follows:

SCRUB BRUSH METHOD.

This consists of a haphazard use of the brush. The brush is held firmly and rubbed with vigour over the surfaces of the teeth and gums. This method does not clean interproximal areas or penetrate fissures. It is best recommended for the occlusal surfaces.

FONE'S METHOD.

This is a more effective method which is easily taught. It is considered suitable for young children who are unable to master a more complex technique. The teeth are held in occlusion and the brush is pressed vigourously against the teeth and gums and revolved in circles with as large a diameter as possible.

THE ROLL TECHNIQUE. (Modified Stillman) FIG 7.

This method is widely advocated, it is simple yet efficient, and can be used in all parts of the mouth. The bristles of the brush are placed as high in the vestibule as possible in the region the sides of the bristles touching the gum tissues. The brush is then moved occlusally while exerting a lateral pressure.

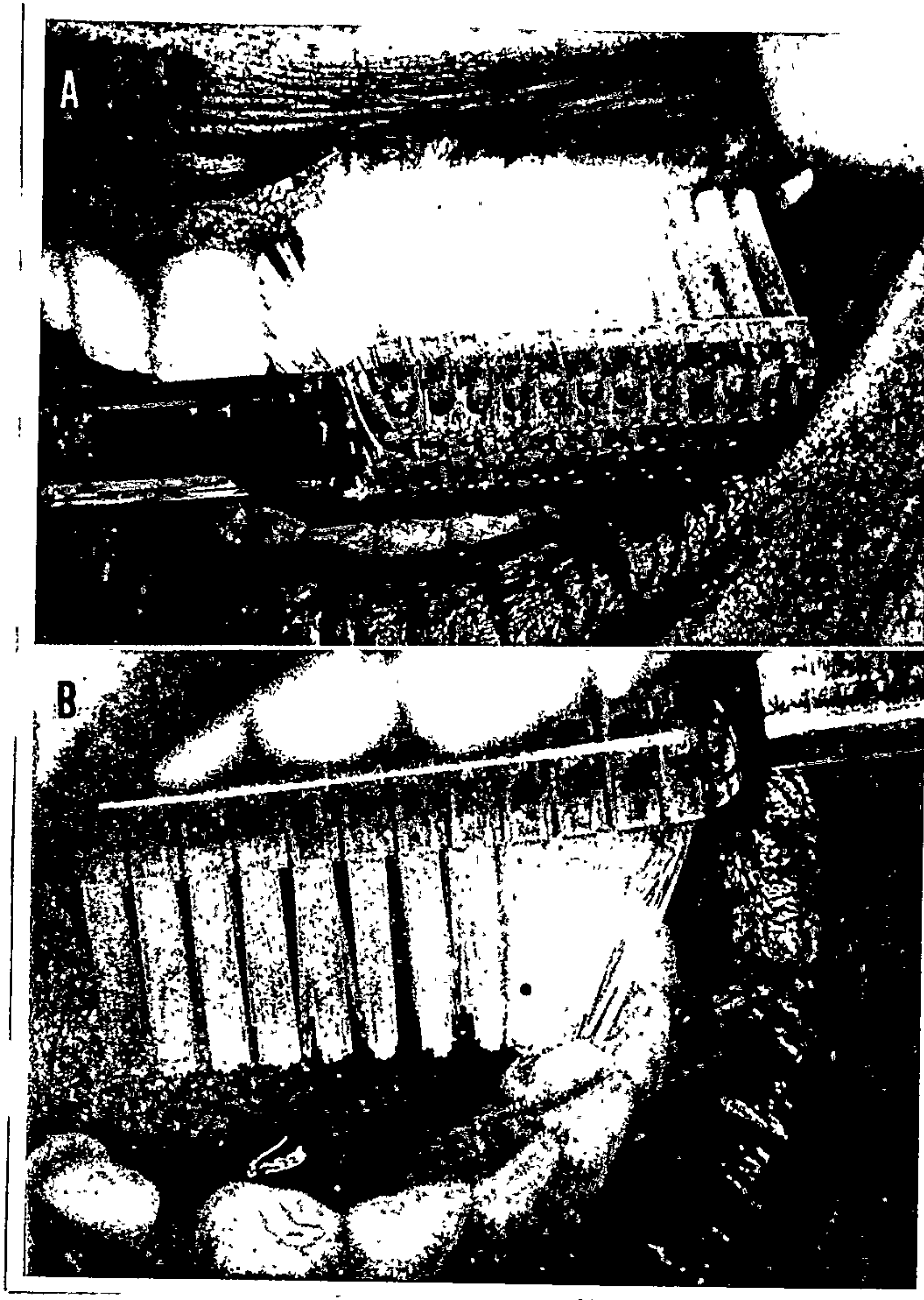


FIG. 3-10. Modified Stillman's Method of Toothbrushing.

A, Brush placement for facial surfaces: *place* brush head parallel to occlusal plane with sides of bristle tips on attached gingiva; rotate head 45° toward teeth and *press* gently until tissue blanches; *vibrate* brush to slow count of ten. *Roll* brushing plane slowly across gingiva and teeth. NOTE: entire length of brushing plane cannot be adapted to teeth and gingiva over cuspid eminences.

B, Brush placement for lingual surfaces, anterior teeth: *place* brush head parallel to long axis of tooth with sides of bristle tips on attached gingiva; *press* gently; *vibrate* brush to slow count of ten. *Roll* brushing plane slowly across gingiva and tooth; bring handle forward and down to cleanse maxillary teeth, forward and up to cleanse mandibular teeth.

During this movement the bristles are held continuously against the gingival tissue. As the brush approaches the plane of occlusion it is turned slowly so that the bristles touch the enamel of the tooth. The pressure causes the gum to blanch as blood is forced from the capillaries, as the brush pressure is released and blood streams to the capillaries again. The action is repeated, an average of eight strokes is recommended before the brush is moved to a new area. This technique cleans the teeth and provides gingival massage.

CHARTER'S TECHNIQUE. FIG 8.

The ends of the bristles are placed in contact with the enamel and the gingival tissue with the brush at an angle of 45° toward the plane of occlusion. Lateral and downward pressure is placed on the brush, and it is vibrated back and forth which forces the ends of the bristles between the teeth, cleaning the interproximal spaces. The process is continued by degrees both buccally and lingually.

STILLMAN'S TECHNIQUE.

The brush is placed in approximately the same position as in the roll method, but closer to the crown. The handle is vibrated gently in a rapid mesio-distal movement forcing the bristles into the interproximal spaces. This method gives both cleansing and gingival stimulation.

BASS TECHNIQUE. FIG 9.

The brush is applied at an angle of 45° to the long axis

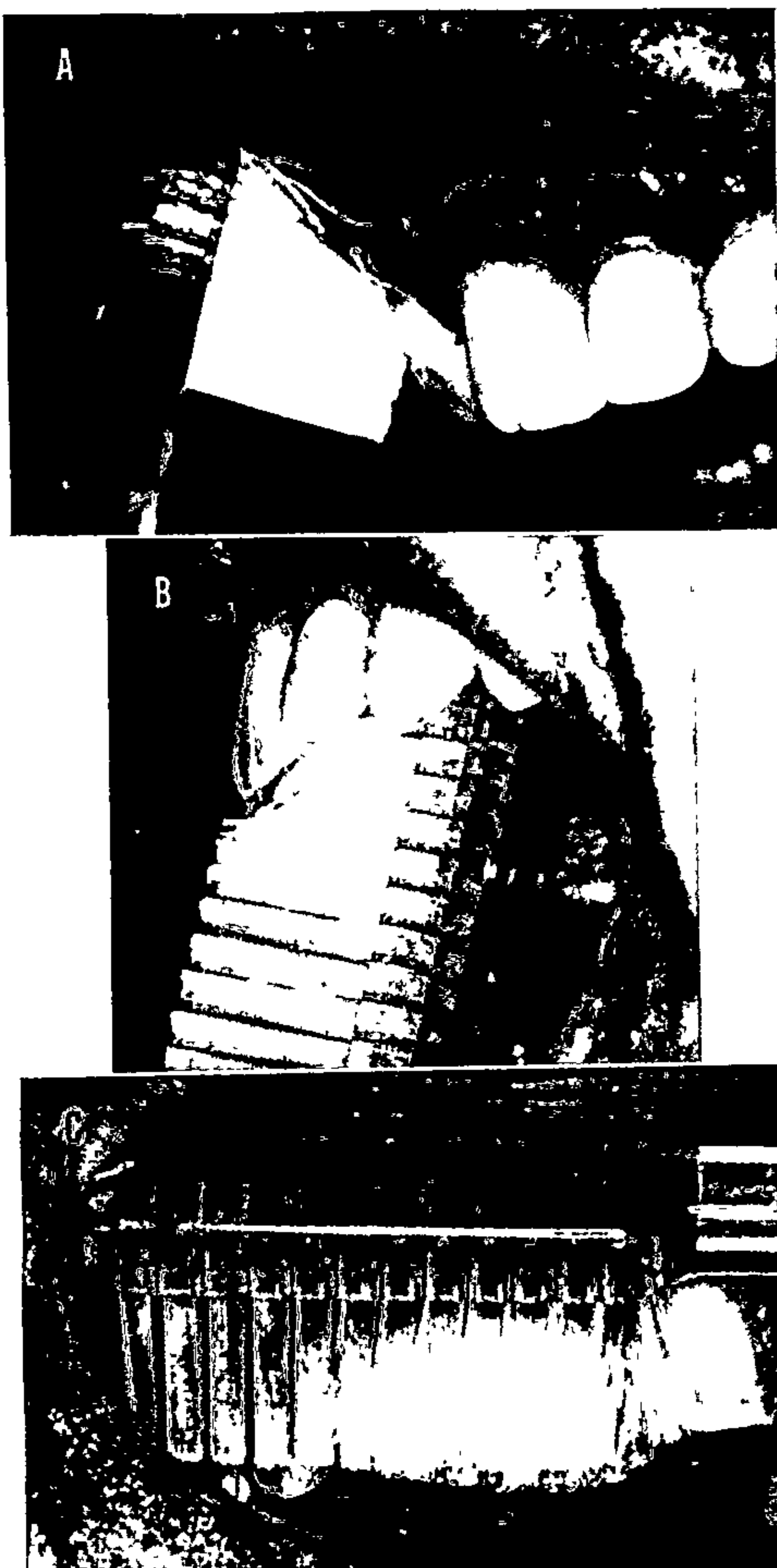


FIG. 3-12. Charters' Method of Toothbrushing.

A, Brush placement, facial surfaces: with bristles directed toward and parallel to occlusal plane, *place* sides of bristle tips to level of gingival margins; turn brush toward teeth, *flex* bristles over teeth and crests of interdental gingiva, maintain gentle pressure and *vibrate* brush to a slow count of ten. Brush placement, and activation on lingual surfaces (not pictured) are similar except only the toe-end bristles are used to cleanse teeth and massage tissue in one embrasure at a time.

B, Brush placement, lingual surfaces, anterior teeth: gently *place* toe-end bristles into interdental embrasure; *flex* bristles onto proximal surfaces and over crest of interdental gingiva, then *vibrate* brush to a slow count of ten.

C, Incorrect brush placement: brushing plane is not parallel with occlusal plane, thus some bristles are pressed too hard against gingiva, others do not reach soft tissues, or tips lacerate gingiva during vibratory movements.

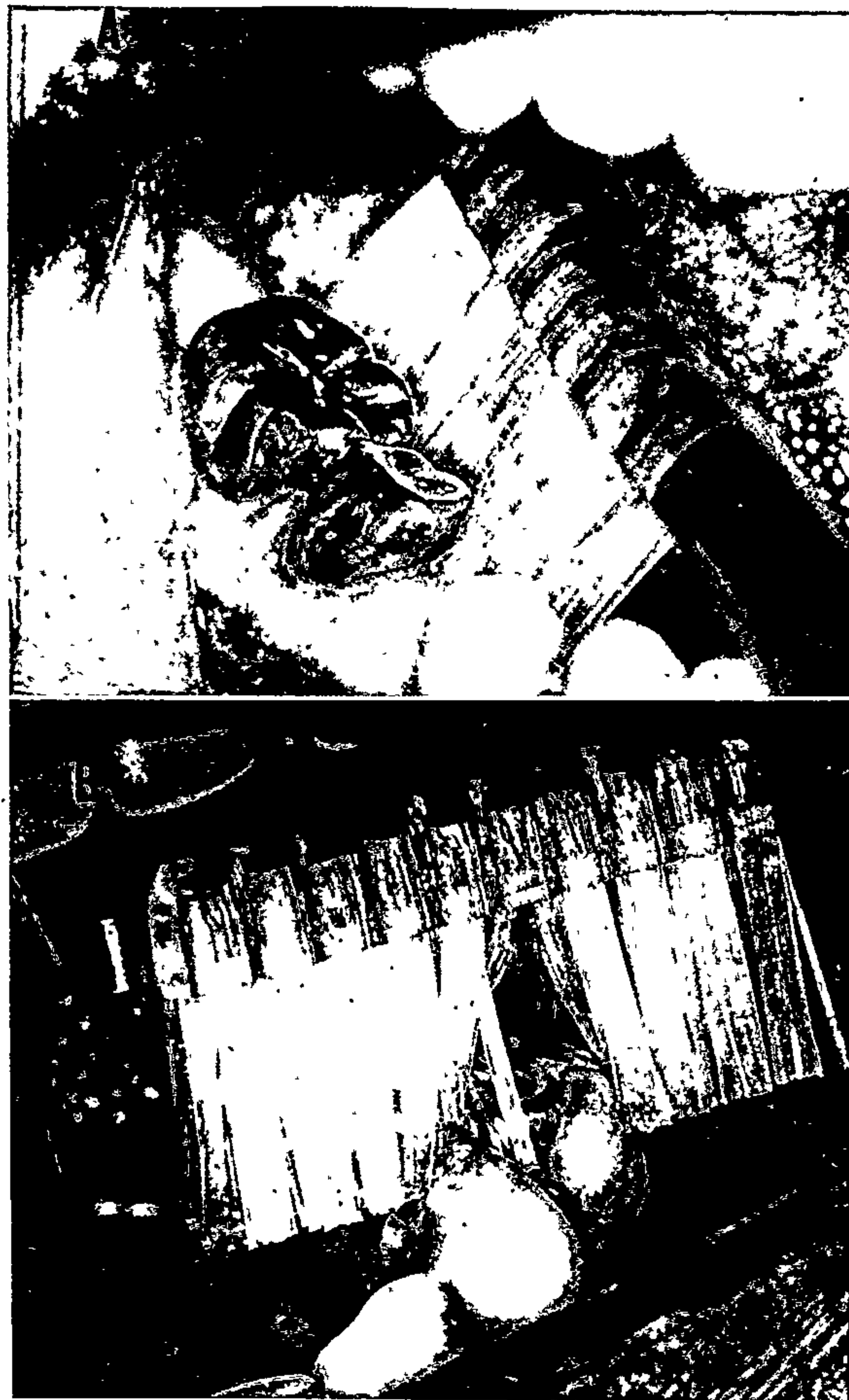


FIG. 3-11. Bass' Method of Toothbrushing.

A, Bristles are directed apically at a 45° angle to long axes of teeth and, with short vibratory strokes, are worked over marginal gingiva and cervical areas onto exposed submarginal surfaces of teeth.

B, Brush placement for hard-to-reach areas, for example, exposed proximal surfaces of teeth adjacent to edentulous areas: brushing plane is placed parallel to proximal surface; bristles are directed apically and at a 45° angle to proximal surface, then with short vibratory strokes, worked over marginal gingiva and onto exposed submarginal surfaces.

of the teeth and is directed toward the gingival margin. As the bristles enter the gingival sulcus the brush is rotated vigorously in a small circle without disengaging the bristle ends from the sulcus. The brush is then moved to an adjacent area of approximately two to three teeth in diameter, and the procedure is repeated.

ROLLING STROKE METHOD. FIG 10

Recommended for patients who have relatively normal tooth alignment and normally healthy gingiva. The method consists of a rolling or sweeping stroke of the brushing plane across gingiva and teeth. Three discrete movements need to be emphasised as the patient learns and practises this method; place sides of bristle tips on the gingiva; press until tissue blanches; roll brushing plane slowly so bristles reach cervical and proximal surfaces of the teeth as well as the interdental gingiva.

LEONARD'S (VERTICAL METHOD).

The brushing plane is drawn up and down over tooth surfaces. The method is simple to learn. With teeth occluded edge, bristles are directed at right angles to the long axis of the teeth and drawn over facial surfaces from maxillary to mandibular gingival margins. When bristles reach marginal gingiva, the brush head is rotated slightly and bristles are flexed into interdental gingiva. The stroke is repeated six times in each brush position. A variation of this method or Fone's method is used to cleanse the lingual surfaces. Care must be taken to avoid excessive pressure as the bristles may strike

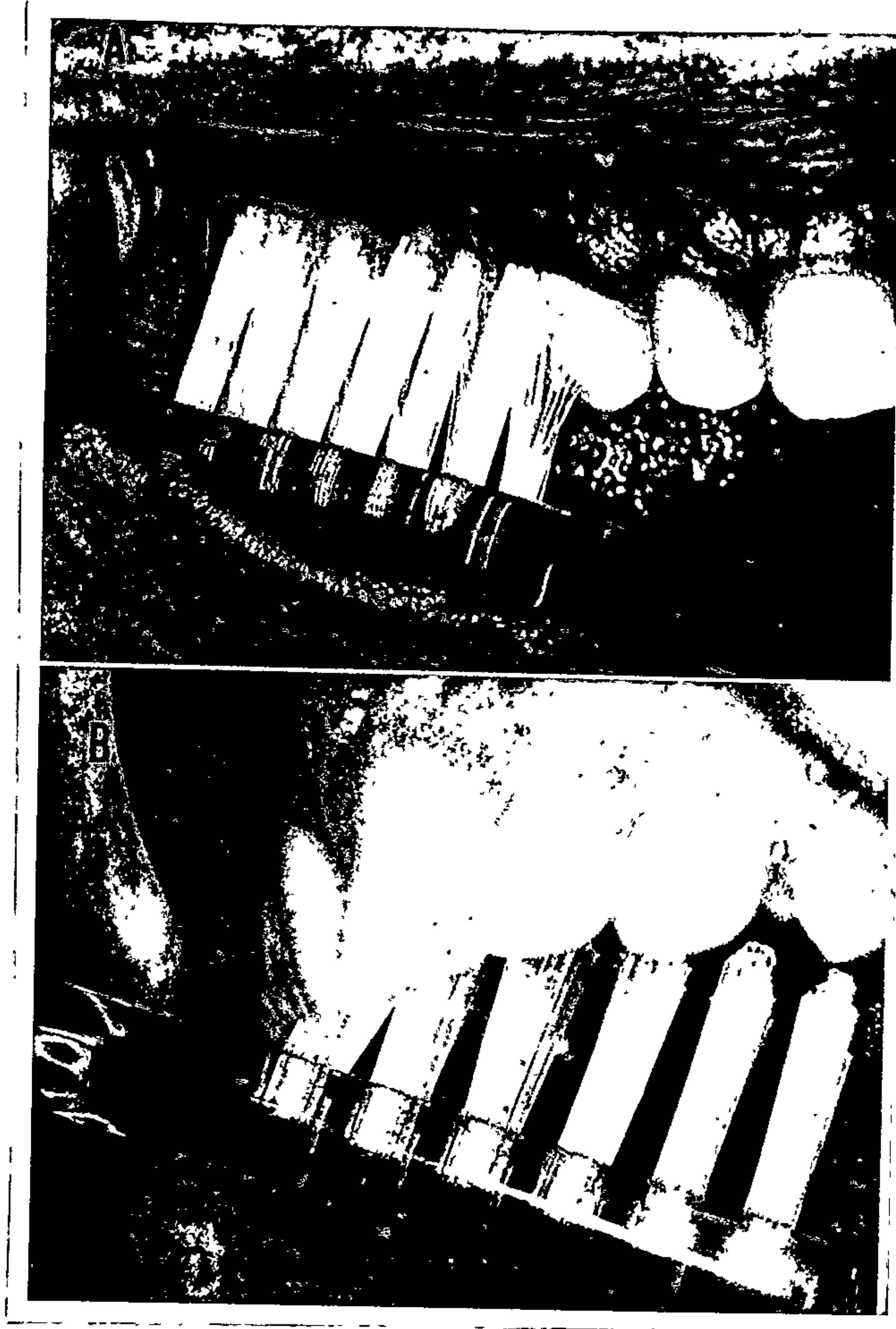


FIG. 3-9. Rolling Stroke Method of Toothbrushing.

A, Brush placement for facial surfaces and posterior lingual surfaces of teeth: *place* brush head parallel to occlusal plane with sides of bristle tips on attached gingiva; rotate head 45° toward teeth and *press* gently until tissue blanches; *roll* brushing plane slowly across gingiva and teeth.

B, Brush placement for lingual surfaces, anterior teeth: *place* brush parallel with long axis of tooth, with sides of bristles on attached gingiva; *press* gently until tissue blanches; *roll* brushing plane slowly across gingiva and tooth. Draw handle forward and down to cleanse maxillary teeth, forward and up to cleanse mandibular teeth.

FIG 10

gingival margins or be flexed onto interdental gingiva forcing the free gingiva away from the teeth and pressing soft debris into the gingival sulci.

THE PHYSIOLOGICAL TECHNIQUE.

Since food is deflected apically during mastication some dentists believe that the gingival should be brushed in the same direction. The tissues are brushed from the crown toward the root in a gentle sweeping motion, this providing good stimulation for the gingiva and interproximal areas.

No specific method of toothbrushing has been accepted as a standard method.

Roth et al⁴⁶ suggested the Roll (modified Stillman) method to be effective in most cases, but other variations have to be substituted to meet individual requirements. Other studies^{48 50} have shown Charter's and the Roll technique to be equally effective in preventing and removing soft accretions from the surfaces of teeth. The Roll method is commonly used^{40, 50} and is often advocated^{47 50}. However, any method needs to be carefully adapted to the need of the individual.^{47 49 50}

The opinions were summarised by Curtis et al⁵⁰ in the conclusion of their paper in 1959. They said: "to receive optimum results from a brushing technique the method should be carefully adapted to the needs of the individual and thorough instruction with supervised periods of drill should be given".

THE EFFECTIVENESS OF TOOTHBRUSHING AS A METHOD OF PREVENTION:

The role of bacterial plaque in providing foci for relatively undisturbed breakdown of fermentable foods to form acids on tooth surfaces has already been mentioned. Although evidence of reductions in dental caries attributable to maintenance of proper oral hygiene by the use of a toothbrush without a dentifrice is inconclusive, deductive reasoning indicates that the teeth should be cleaned as soon as possible after eating.

Since the primary objective of brushing is to clean the teeth, any method that will effectively reach and clean caries susceptible areas is preferable. A technique which uses disclosing solutions to evaluate the effectiveness of the patients efforts and to adjust his techniques is desirable.

The efficacy of toothbrushing alone, with or without a neutral dentifrice needs consideration. Fosdick⁵¹ found reductions in caries of 41 per cent by explorer and 60 per cent by X-Ray among 702 individuals, 429 of whom brushed for 10 minutes with a neutral dentifrice after ingestion of food or sweets over a two year period. This study has been the subject of considerable criticism in the literature. (Dunning)¹⁰.

Hein⁵² found in a limited study that there was no appreciable affect on dental caries in a group of 60 males who brushed once or twice a day. While a group of females who brushed four times a day showed less caries than a group who brushed once, twice and

three times a day. The frequency of brushing had little effect on caries in a group of 155 males.

A study by McClure⁵³ on toothbrushing techniques for the preschool child was conducted on 175 children in a pedodontic practice, his findings were:

- (1) Some 3-5 year old children were unable to wield the toothbrush.
- (2) Scrubbing horizontally was more effective than the Roll method for the primary dentition.
- (3) The parent brushed more effectively than the child.
- (4) The parent brushed more effectively after instruction.

In 1968, Rodda⁵⁴ made a comparative study of four methods of toothbrushing methods, and their effectiveness in removing stainable plaque from the buccal and lingual tooth surfaces in a group of dental students. His findings agreed with those of McClure that the horizontal scrubbing method was more effective, and that McClure's findings could be applied to a group of adult males. Rodda⁵⁴ found the simplest horizontal method was the most effective in removing stainable plaque. There was no clinically significant difference between the Fones and the Roll method, but the Charter's method resulted in significantly higher oral hygiene scores when compared with the other three months.

The difficulty of reaching all the exposed surfaces of the tooth on which plaque may form is the prime disadvantage of any

brushing method (Dunning)¹⁰. The toothbrush is effective in plaque removal for the surfaces which can be reached but because the plaque requires an abrasive for dislodgement²¹ a dentifrice must be used.

The time taken for brushing has an effect on the efficiency of any method. Robinson⁴⁷ found that the time the average young adult spent in brushing was about 67 seconds. This is clearly inadequate for a minimum time of half a minute on each quadrant buccal and lingual plus the occlusal surfaces would require 6 minutes.

Toothbrushing can be said to be effective for the removal of plaque and therefore a useful preventive measure for dental caries. A dentifrice should be used in conjunction and because all surfaces cannot be reached additional aids are required particularly for the interproximal areas. Training is required to achieve an adequate method for each individual and proper application for a reasonably adequate time needed.

TOOTHBRUSHES ELECTRIC

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There has recently been a wide interest in the use of electric toothbrushes for general use. The characteristics of such brushes should conform with the specifications for manual brushes in that they should be inexpensive, durable, and able to be readily cleaned and aerated. 43

A commercially available automatic brush (Broxodent) FIG 11

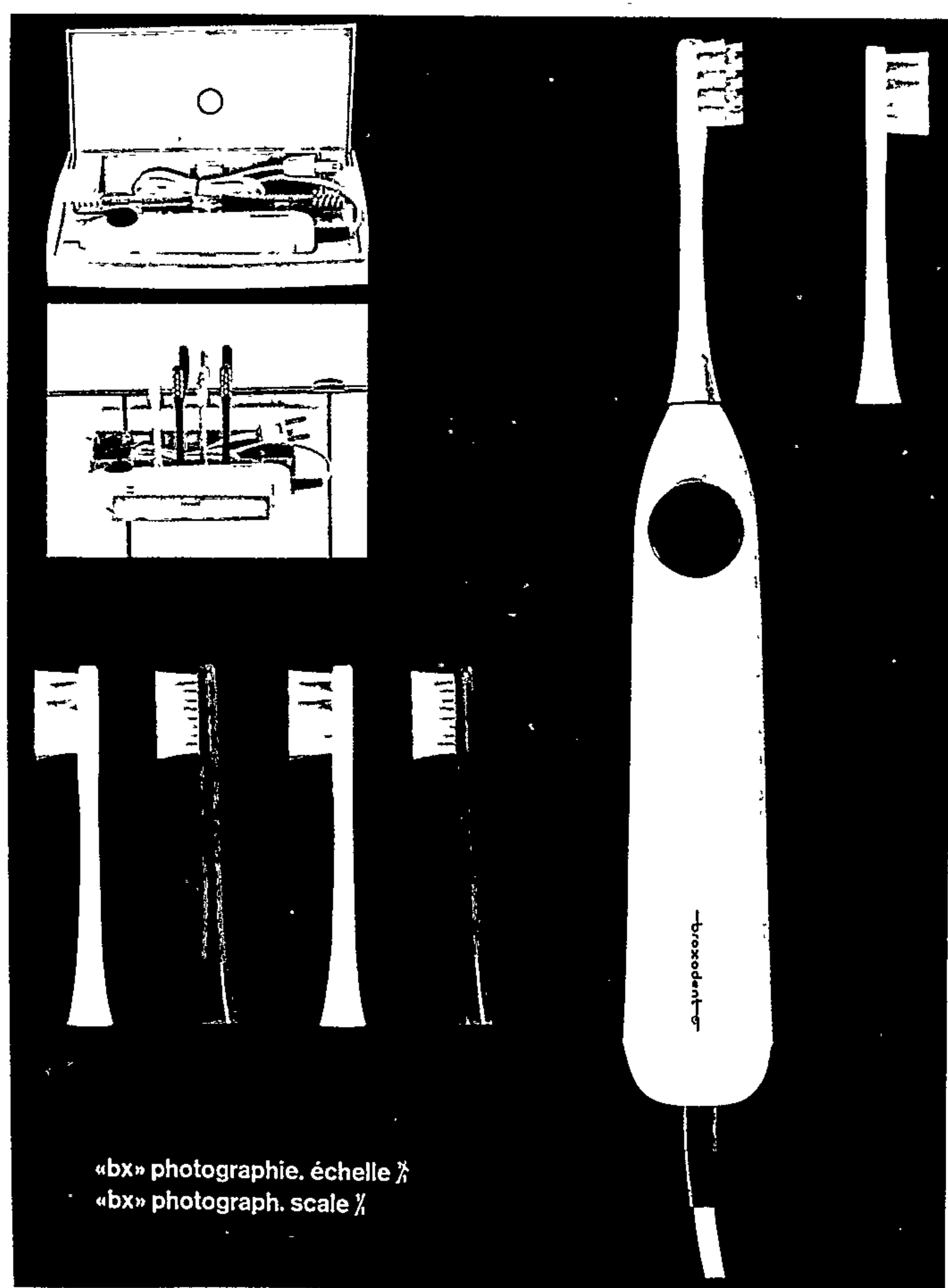


FIG 11 REF-39

has a small detachable brush head, the bristles being round ended and made of a synthetic fibre known as Rislán. The motive power is provided by an oscillating induction motor which is doubly insulated and hermetically sealed into a nylon cased handle. The motor has no brush gear and starts as soon as it is plugged in but may be braked by two buttons mounted on the forward end. As the brush head is guided horizontally along the teeth it rotates to and fro through a vertical angle of 60 degrees at fifty cycles per second. The brushing action is vertical over the teeth, sweeping out and away from the gums. Brush heads may be sterilised by boiling, autoclaving or chemical disinfectants.

The initial cost is fairly high but the readily replaceable detachable heads allow the one motor to be used for a group of individuals.

Goldman et al³⁷ stated that there is a general misconception that no special instruction is required for their use. They emphasised that instruction with this type of brush is just as necessary as it is with the manual toothbrush.

Studies⁵⁶⁻⁵⁹ conducted to test the effectiveness of the short stroke reciprocating action electric toothbrush as a tooth cleaning agent have found it to be the equal of a manual toothbrush in the hands of a reasonably manually adept adult. No conclusive evidence of superiority was found.

Many physically handicapped children do not possess the necessary manual dexterity to clean their teeth efficiently with a manual tooth brush, with the result that their oral hygiene is generally poor. The cleaning of these childrens' teeth by other people often produces disappointing results as conventional tooth brushes are not designed to be used in this way and the operation is difficult and time consuming.

Vowles,⁶⁰ made a controlled study of a group of 20 spastic children in a residential school to compare the effectiveness of an electric brush (Broxodent) and a soft multitufted nylon toothbrush. The results showed a clear superiority for the automatic brush, the total improvement being 2.8 times as great as that shown with the conventional brush. The automatic brushes were readily accepted by both the children and the house mothers. The children found the larger diameter of the motorised handle easier to grasp and manipulate than the conventional handle.

A similar study by Smith and Blakenship⁶¹ reported equally encouraging results for physically handicapped children.

Although it has not been conclusively demonstrated that the electric tooth brush is superior to the conventional brush, it is at least equal in its effectiveness for cleaning plaque, debris, and stain from the teeth in the hands of a reasonably adept person. The published reports do indicate the superiority of the powered brush in carrying out oral hygiene procedures for the physically handicapped.⁹⁶

INTERPROXIMAL CLEANING

In contrast to the facial and lingual surfaces of teeth, the interproximal surfaces are relatively inaccessible to the tooth brush. Demonstration of this fact is the inevitable interproximal retention of disclosing stain even after the most meticulous brushing. A great deal of hygienic aids and procedures have been developed for use in these areas. Although specific indications for each may occur none is so consistently effective as the habitual use of unwaxed dental floss.³⁷

In 1948, Bass⁶² published specifications for unwaxed floss as well as a rationale for its use. He recommended a high tenacity nylon yarn twisted together to form a strong, thin strand of 34 individual filaments.

Thin unwaxed floss has decided advantages over the thicker waxed variety commonly used. Basically this is too thick, teeth are forcibly separated by its insertion causing discomfort which destroys the possibility of habitual use. The wax coating can be trapped between the teeth causing further discomfort. All the filaments are waxed together as one strand, creating a single cutting strand which reduces the effectiveness for cleaning the interproximal areas of plaque and food debris.

The thinner unwaxed floss can be passed through the contact areas gently causing little discomfort. A gentle sawing

motion is used to ease the floss through the contact area so that it does not snap through causing damage to the soft tissues located apically. Once past the contact area a wiping sawing movement is used against each adjoining surface in the interproximal space. As the floss is pressed against the tooth surfaces, the filaments separate, and each becomes an individual cutting surface removing and entrapping the accumulated bacterial mass and food debris.³⁷

The importance of cleaning the contact and interproximal areas cannot be overstressed. Floss has the advantages of being portable and performing the tasks for which it was designed very well. Thin unwaxed floss is superior to the thicker unwaxed varieties.

Other devices used for the cleaning of the interproximal area include various types of tooth picks, yarns of various sizes small brushes and rubber tips. O'Leary⁶³ does not believe that rubber tips can remove all the interproximal plaque, but achieve a significant reduction. The specially designed soft wooden interdental cleaners, now available, effectively clean the interproximal tooth surfaces below the contact area and have the desirable qualities that little chair side instruction is required for their use and they may be used by the patient in any environment. Other varieties of tooth pick made from hard and often brittle materials can cause damage to the soft tissues and as they do not maintain

close contact with the tooth surface they remove little plaque.

The use of interproximal cleaning aids are a necessary adjunct to toothbrushing to effect a satisfactory oral hygiene regimen. Unwaxed dental floss and soft wooden interdental cleaners have been shown to be the aids of choice for the motivated individual.

HYDROTHERAPY

The concept of oral irrigation for cleansing the teeth and surrounding soft tissues is not new. As early as 1924 the use of a rubber bulb syringe for irrigating the subgingival space was advocated by G. V. Black. Today mechanical devices which deliver a high pulse water spray are available. The pulse of water strikes the teeth and gingiva at a regular frequency. The gingiva are compressed and blanch when struck by the water pulse. The frequency of such striking and the consequent blanching can serve as a massaging action. The volume of water and the force with which it strikes the teeth may serve to dislodge and wash away debris from the tooth surfaces.

A number of short term studies have been carried out on the effectiveness of these devices. In general the investigators have found an improvement in gingival health status in experimental subjects when compared with control subjects. The consensus is that these devices are useful for removing loose food particles and oral debris.³⁷ Some studies have reported decreases in plaque formation but most published reports do not support this finding.^{64 65 66}

O'Leary⁶⁷ et al pointed out possible harmful effects, including periodontal abscess formation and possible penetration of crevicular tissue by bacteria and other particulate matter.

On the basis of the short term studies conducted pulsed water irrigation would appear to be a useful adjunct to brushing and interdental cleaning procedures, in that soft nonadherent deposits

are removed. There is insufficient evidence to indicate that their use is an effective means for the removal of bacterial plaque.²²

ORAL RINSING

Where toothbrushing may be inconvenient after a meal or after between meal snacks oral rinsing can be helpful in promoting the clearance of fermentable carbohydrates. In connection with the Vipeholm studies of dental caries in Sweden a group of 50 students were given taffy. The subjects were tested twice, with and without a vigorous rinsing of 20 ml of water. The results showed more than three times as many of the subjects with high carbohydrate concentration without rinsing as did the individuals after rinsing. This technique can be of great value in situations where toothbrushing cannot be accomplished, but should not be considered a satisfactory substitute for careful toothbrushing. (Dunning)¹⁰.

DETERGENT FOODS

There are two ways in which diet may act upon the teeth and play its role in the prevention of dental caries. The first is through the oral environment, by controlling the lodgement around teeth of fermentable carbohydrate debris which clears slowly from the mouth. The second is through general nutrition. (Dunning)¹⁰.

The effectiveness of fibrous foodstuffs as a means of clearing oral debris from the mouth was considered by Knighton,⁶⁸ who observed that apples, sliced oranges, and some other foods were able to achieve results superior to tooth brushing with a dentifrice for 3 minutes followed by water rinsing.

In 1963, Arnim³⁸ reported the results of a study in which a technique had been developed to record quantitative measurements of stained microbial deposits on teeth. This technique was applied to study the cleansing effectiveness of fresh sugar cane, fresh unpeeled apple, celery, lettuce and uncooked carrots. The findings were that no teeth were cleaned perceptibly on approximal surfaces, nor were they thoroughly cleansed on any surface, save possibly the occlusal. Thick microbial deposits were found on most surfaces tested. Arnim noted that remaining adherent plaque was found in exactly the locations where periodontal disease and dental caries begin. FIG 12.

Fibrous foodstuffs, chewed after soft foods remove debris and soft deposits from the teeth. This is useful when other means are not readily available, eg school lunches.

CHART I
TRACINGS OF TEETH SHOWN IN PLATE I (MICROCOSMS IN RED)
Dec. 1950

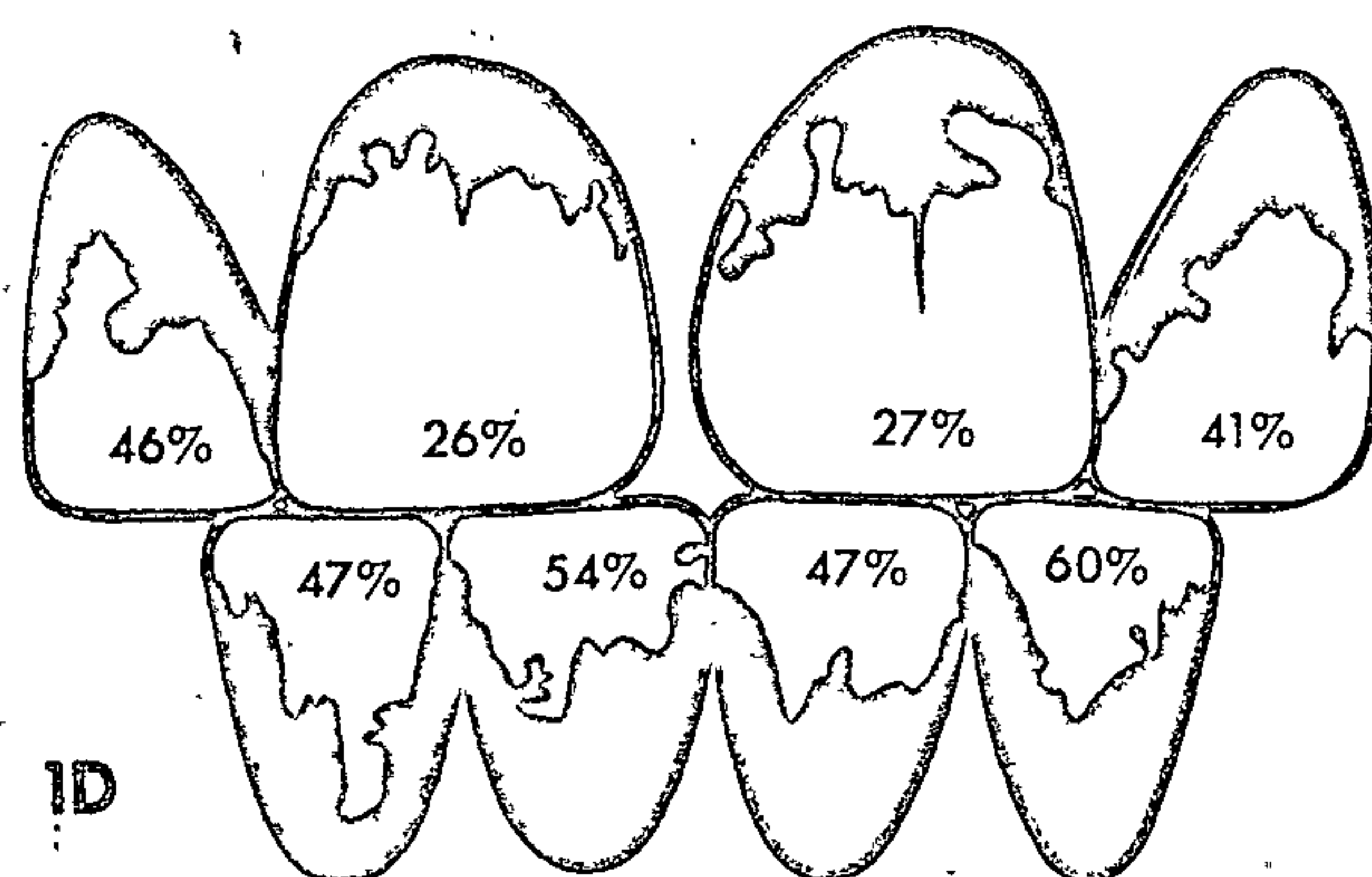
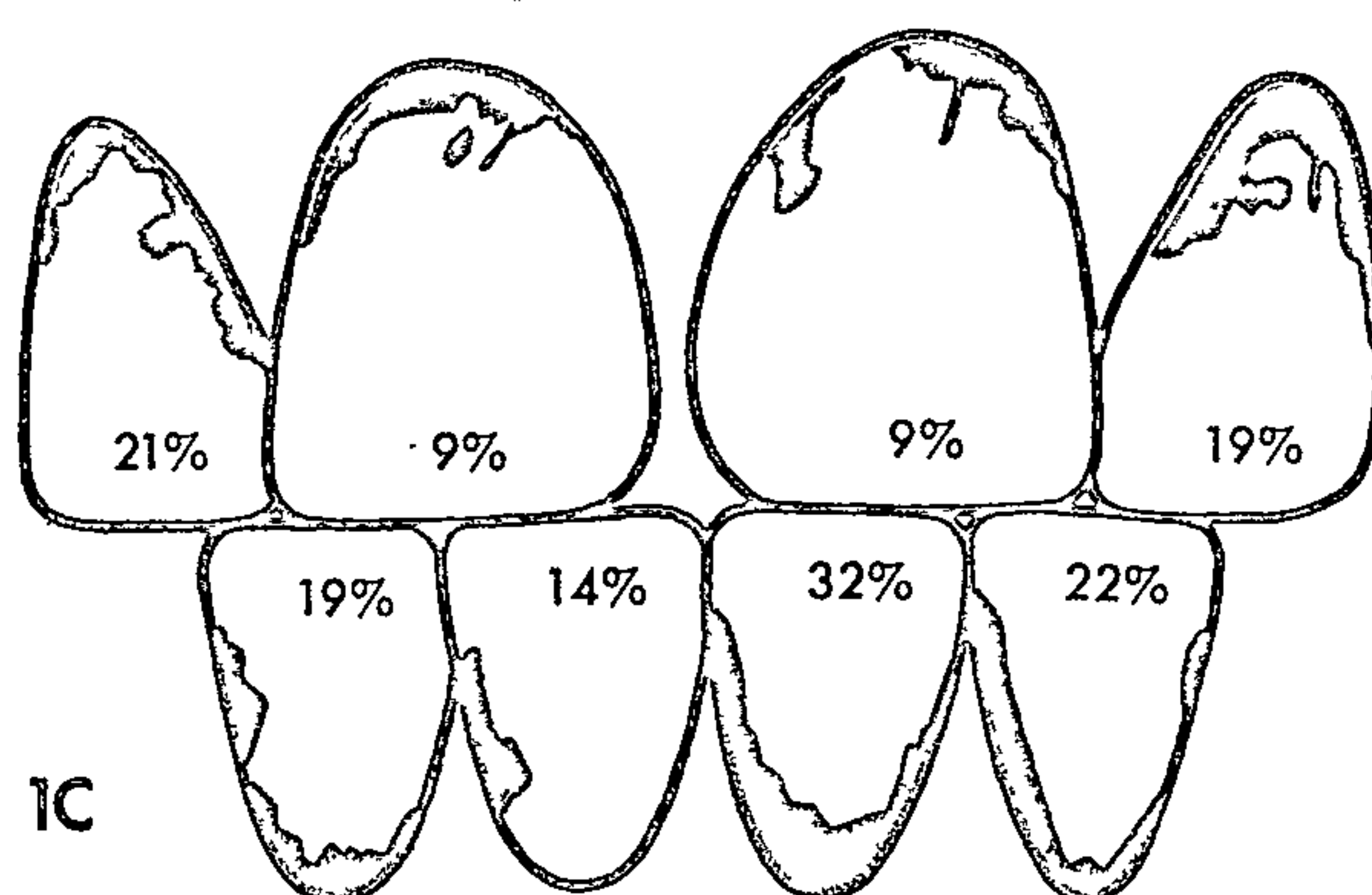
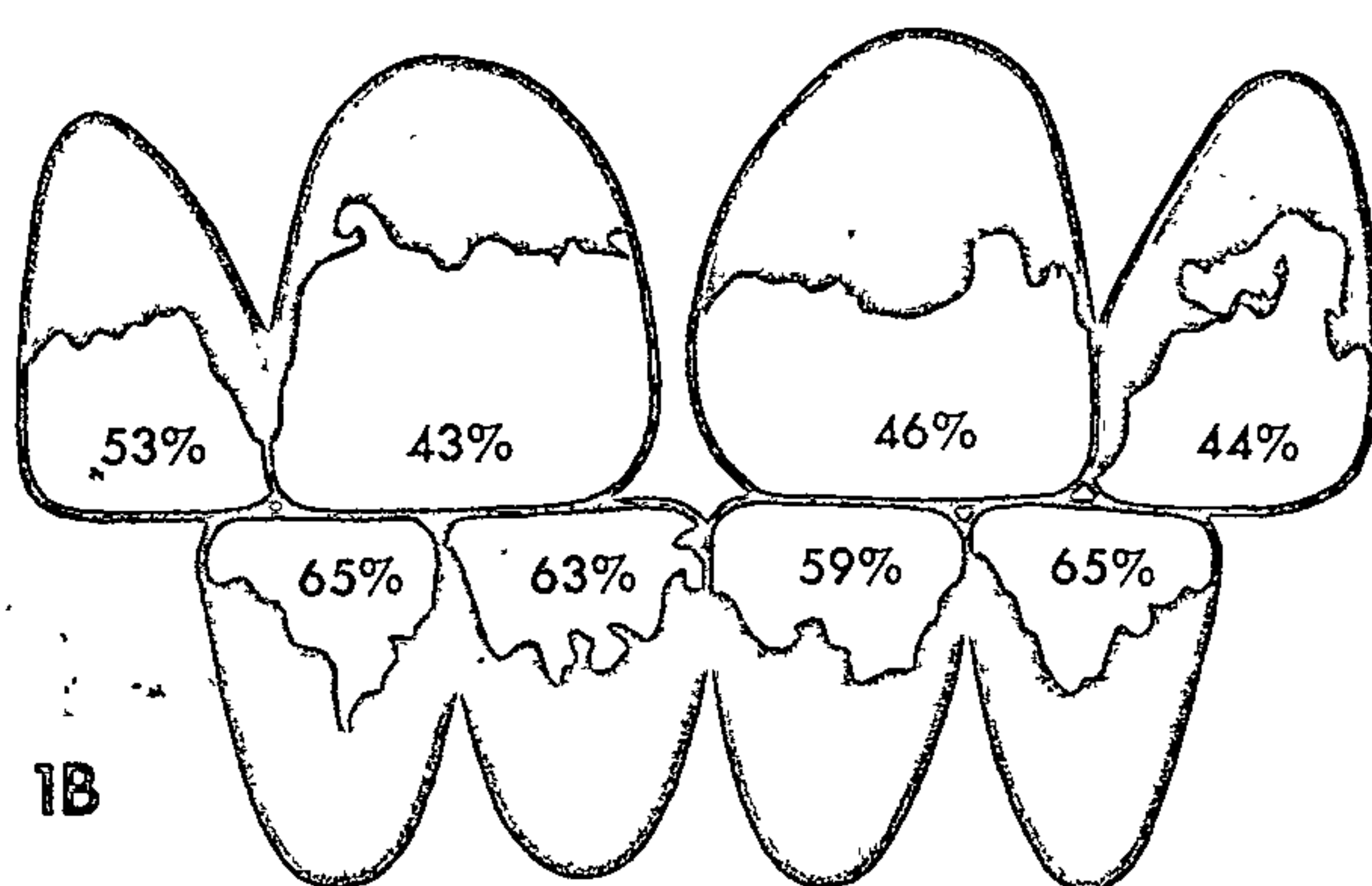


TABLE I

Planimeter Measurements of Teeth Shown in Plate I

	Percentage of Labial Surface Covered by Microcosm							
	Maxillary				Mandibular			
	2	1	1	2	2	1	1	2
1B. 7 day growth of microcosm, stained	53	43	46	44	65	63	59	65
1C. After chewing 3 hours, not restained	21	9	9	19	19	14	32	22
1D. Same microcosms, restained	46	26	27	41	47	54	47	60
1B minus 1D. Percentage tooth surface cleaned by chewing fibrous food	7	17	19	3	18	9	12	5

They exhibit little effect on the adherent bacterial plaque in the locations prone to the onset of dental caries.

Caldwell,⁶⁹ observed that the extent to which detergent foods contribute to caries prevention is questioned. They have use in removing loosely adherent foodstuffs from the surface of plaque but are not likely to be effective in removing the underlying fixed portions of the plaque.

DENTIFRICES

A dentifrice is a substance used with a toothbrush for the purpose of cleaning the accessible surfaces of the teeth.⁴³ Dunning¹⁰ quotes the advice of the American Dental Association when it said:

"The function of a dentifrice, whether it is a paste, powder, or liquid, is to aid the brush in cleaning the teeth. Don't expect your present dentifrice to do more than this." The Council on Dental Therapeutics of that association does not consider for acceptance ordinary cleansing dentifrices without therapeutic or prophylactic effect.

Dentifrices as at presently compounded consist chiefly of a combination of:

1. Detergents.
2. Abrasives.
3. Thickeners and moisture retaining agents.
4. Flavouring and sweeteners.
5. Colouring agents.
6. Therapeutic agents.

(Ware and Chong)⁷⁰

DETERGENTS.

Detergents are used to lower the surface tension with the purpose of breaking up adherent food residues and mucous plaques, penetrating areas inaccessible to the brush and providing foaming properties.

In the early 1930's and until the mid 1940's soap was the

agent used in most dentifrices. Soap had disadvantages in that it was not compatible with many of the calcium salts used as abrasives, only a limited number of flavouring agents could be used, and as it was only effective in an alkaline solution some dentifrices were so alkaline as to damage the mucosa. The result was that many dentifrices containing soap did not possess the necessary consumer appeal, particularly for taste.²⁹

Various synthetic detergents were proposed; these have the same qualities as soap in lowering surface tension and providing a foaming agent but are compatible with other ingredients. Most modern dentifrices use synthetic detergents; common ones are sodium lauryl sulphate and sodium N-lauryol sarcosinate. Although claims have been made for special advantages of detergents, Ware and Chong⁷⁰ did not find them to be substantiated and concluded that detergents must be used in association with an abrasive to have a cleansing effect.

ABRASIVES.

The abrasive agent used in a dentifrice must be carefully selected not only for its hardness but for its grading so that it will not cause more abrasion than necessary to remove food debris and plaque.⁷⁰

People vary in their need for the abrasive potential of a dentifrice.⁷¹ In the United States it has been found that 85 to 90

per cent of the population require a dentifrice containing an abrasive to effectively remove the stained deposits on their teeth. A dentifrice that has good cleaning properties and produces a high polish is desirable because a highly polished tooth surface will stain less readily and remain clean longer. (Muhler)²⁹

Dentifrices in the form of powders and pastes contain abrasives such as calcium carbonate, one or more of the calcium phosphates, calcium sulphate, insoluble sodium metaphosphate, hydrated aluminium oxide, magnesium carbonates and phosphates, sodium bicarbonate and sodium chloride.

Commercial dentifrice powders are generally more abrasive than pastes. Table 3 from *Accepted Dental Therapeutics*, 1967, gives a comparison of the rotary brush abrasion loss on human teeth by various abrasive agents.

Rotary Brush Abrasion of Human Teeth ³	
Abrasive	Abrasion loss (mm.)
Calcium carbonate, extra dense	0.012
Light chalk, USP	0.003
Extra light chalk, USP	0.003
Bentonite	0.006
Flour of pumice	0.300
Levigated alumina	0.300
Hydrated alumina	0.002
Dibasic calcium phosphate, dihydrate	0.001
Dibasic calcium phosphate, anhydrous	0.021
Tribasic calcium phosphate	0.001
Stannic oxide CP	0.083
Zinc oxide	0.003
Calcium pyrophosphate	0.005
Magnesium trisilicate	0.009
Insoluble sodium metaphosphate and dibasic calcium phosphate, dihydrate (1:1)	0.001

TABLE 3

Although the ability of a dentifrice to remove stains may be related to its level of abrasiveness, some laboratory and clinical studies suggest that beyond a certain abrasive level, no significant gain in stain removal is observed.⁷⁰ The Council on Dental Therapeutics of the American Dental Association considers that there is no valid reason for the use of a dentifrice with a greater abrasiveness than to prevent residual accumulation on the teeth and that some of the products advertised for their ability to whiten teeth are too harsh for regular use.³⁷

THICKENERS AND MOISTURE RETAINING AGENTS.

Agents such as sorbitol and glycerine, fillers and water which should produce a consistency which will allow easy extrusion from the tube in winter and summer. The dentifrice should flow from the tube and retain its form when placed on the toothbrush.

FLAVOURING AND SWEETENING AGENTS.

A variety of materials such as oils of peppermint, cinnamon, eucalyptus, wintergreen and cloves, menthol, methyl salicylate, thymol, anise, musk, and fruit flavours are among those used. Fermentable sugars and alcohols should not be used for either flavour or sweetening. Artificial sweeteners, saccharin and sodium cyclamate, are commonly used, although doubt has been raised of the safety of the cyclomates due to carcinogenic potential.

The value of a pleasant flavour, with variety to suit the

public taste is that it is often the chief factor in the choice of a dentifrice and its continued use.⁷⁰

COLOURING AGENTS.

The colour is not important as long as it does not stain the teeth or other oral tissues. White is as popular as any colour.⁷⁰

THERAPEUTIC AGENTS.

Many claims have been made for preparations which render teeth immune from attack and maintain the health of the teeth and periodontal tissue.

A wide range of compounds of ammonia, urea, and urease for neutralising acid attack, chlorophyll for deodorising and inhibition of oral bacteria, antibiotics, antienzymes, vitamins and more recently fluorides, have been considered experimentally.

The present position of anti caries agents as additives to dentifrices is reviewed from the available literature.

AMMONIUM; UREA.

These compounds contain chemicals that have either active ammonia compounds or compounds which are converted to active ammonia in the mouth, resulting in less acid being formed in the dental plaque. Slack⁷² reported that the results of studies to test their effectiveness were indecisive. The Council on Dental Therapeutics stated that although one product showed some value there was not enough clinical evidence available for it to be given an approved category.

CHLOROPHYLL.

Few clinical trials have been conducted, although some tests showed an initial benefit, prolonged usage resulted in no benefit at all. (Slack)⁷².

ANTIBIOTICS.

The consensus of opinion is that great restraint should be exercised for fear of creating resistant strains of pathogens. Tests with penicillin and tyrothricin have shown positive results, but there is no confirmation of their effectiveness in caries reduction.⁷⁰

ENZYME INHIBITORS.

Antienzyme dentifrices are thought to act in a similar manner to antibiotics in principle, but instead of interfering with bacterial growth they are thought to effect the enzyme systems required for the breakdown of foods by bacteria to form acids. The most promising, sodium N-lauroyl sarcosinate is a detergent used as a foaming agent in dentifrices as (Gardol^R). Fosdick⁷³ found positive results, but later studies gave negative results. Sufficient clinical evidence is not available for these dentifrices to be given an approved category in Accepted Dental Therapeutics.⁴³

FLUORIDE COMPOUNDS.

Stannous fluoride: Studies on human subjects who used dentifrices which contain stannous fluoride indicated that the regular use

of some of these products results in a reduction in the incidence of dental caries. Statistical analysis of the data presented indicated the reduction to be a valid one. Dentifrices (Crest^R and Gue^R)^{74 75} have been classified in GROUP A in Accepted Dental Therapeutics.³⁴ The formulation of (Crest^R) is as follows: stannous fluoride, 0.4 per cent; stannous pyrophosphate, 1 per cent; calcium pyrophosphate, 39 per cent; glycerin, 10 per cent; sorbitol (70 per cent solution), 20 per cent; water, 29.6 per cent; and miscellaneous formulating agents.

Dentifrices containing stannous fluoride have been the subject of a number of clinical studies; the data has been generally consistent in that the test groups exhibited fewer new carious lesions during the study period than did the control groups.

Fanning et al.⁷⁶, in a two year study, reported a reduction of 27 per cent new decayed tooth surfaces in the second year, and 21 per cent fewer cavities for the two year period, for high school children using dentifrices containing (a) 0.4 per cent stannous fluoride and (b) 0.76 per cent monofluorophosphate.

A later report⁷⁷, 1971, from that study, found that the most protection was derived on the proximal and free smooth surfaces of the molars and premolars. A similar relative effect was seen in the number of surfaces of anterior teeth, but the incidence of new caries was too small to demonstrate a statistically significant difference.

No significant difference was detected between the two

types of fluoride dentifrices.

Gish and Muhler⁷⁸ published a report of a follow up study on the effectiveness of a stannous fluoride pyrophosphate dentifrice used by children whose teeth calcified and matured in an area where the water supply contained an optimal level of fluoride. FIG 13.

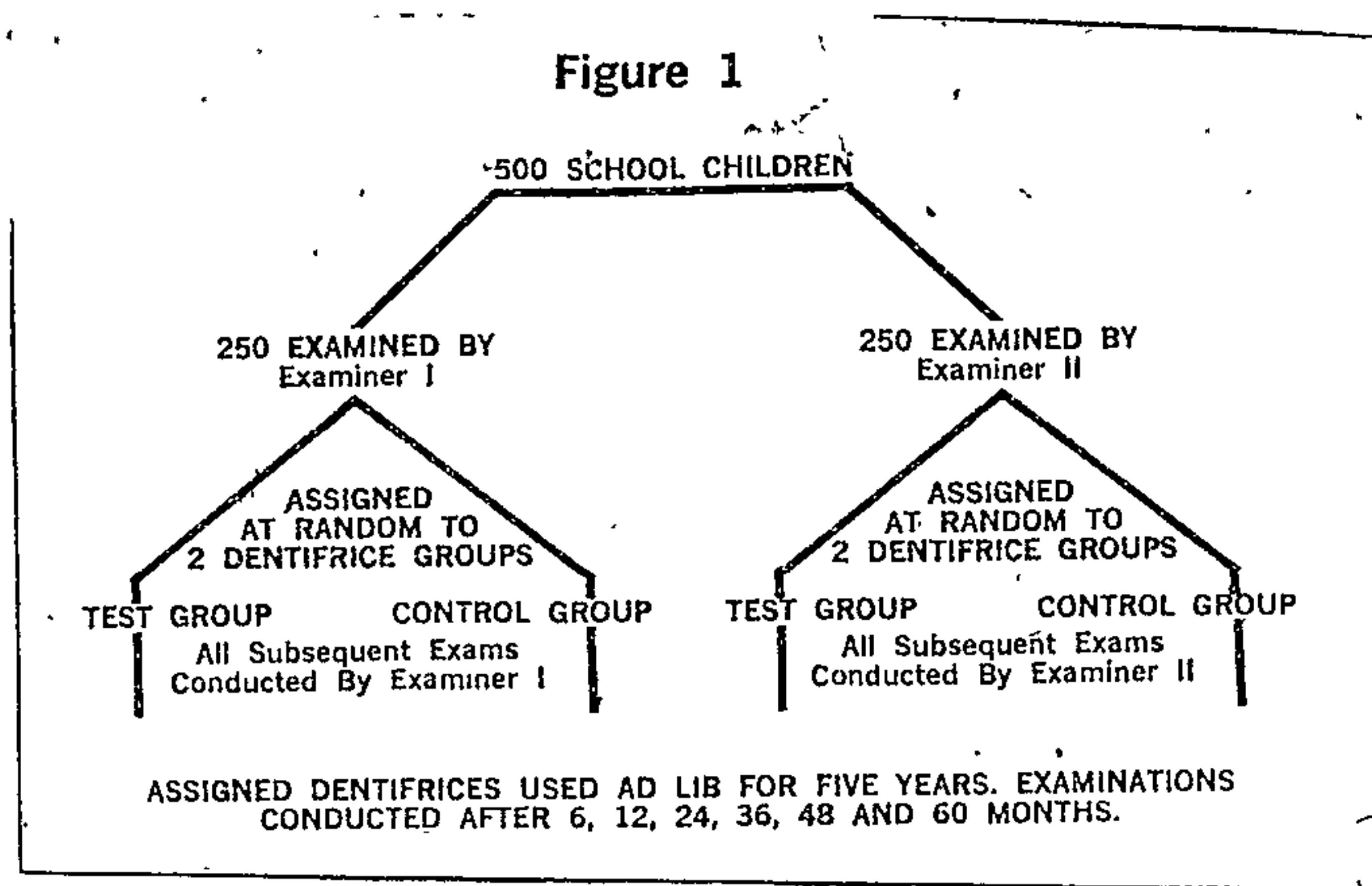


FIG 13 REF-78

This study was after five years, the initial study one⁷⁹ and two⁸⁰ years had demonstrated significant reduction in dental caries in addition to the anticariogenic effect of the water.

The data Tables 4-7⁷⁸ showed a significant additive effect for the dentifrice after five years.

Results of studies^{81, 82} in areas where the water supply did not contain an optimum fluoride level showed an even higher per cent reduction in caries, up to 46 per cent D M F S.

Table 1
Initial Balance of Subjects Completing Indicated Portion of the Study

		Examiner I			Examiner II		
		N	Age		N	Age	
			Mean	Range		Mean	Range
6 Month Exam	Control	114	9.32	6-14	99	9.17	6-14
	Test	112	9.49	6-14	105	9.05	6-12
12 Month Exam	Control	112	9.37	6-14	93	9.16	6-13
	Test	105	9.60	6-14	102	9.03	6-12
24 Month Exam	Control	108	9.30	6-13	93	9.13	6-13
	Test	95	9.56	6-14	99	9.03	6-12
36 Month Exam	Control	77	9.22	6-12	86	9.03	6-13
	Test	73	9.42	6-12	92	9.03	6-12
48 Month Exam	Control	91	9.18	6-13	77	8.87	6-13
	Test	79	9.33	6-13	85	8.94	6-12
60 Month Exam	Control	79	9.13	6-13	68	8.79	6-13
	Test	75	9.32	6-13	81	8.96	6-12

*Number in parenthesis is the standard error of the mean.

TABLE 4 REF 78

Table 2
Results in Terms of DMFT and DMFS Increments for Subjects Completing the Indicated Portion of the Study.
(Examiner I)

		N	DMFT			DMFS		
			Mean	% Red.	Prob.	Mean	% Red.	Prob.
6 Month Exam	Control	114	0.85(.120)*			1.48(.198)		
	Test	112	0.54(.117)	36.5	.0676	0.67(.157)	54.7	.00133
12 Month Exam	Control	112	1.33(.135)			2.40(.274)		
	Test	105	1.12(.151)	15.8	.29834	1.48(.212)	38.3	.00781
24 Month Exam	Control	108	2.12(.204)			3.73(.398)		
	Test	95	1.63(.201)	23.1	.08727	2.41(.297)	35.4	.00781
36 Month Exam	Control	77	2.88(.262)			5.05(.538)		
	Test	73	2.45(.303)	14.9	.28462	3.44(.426)	31.9	.01877
48 Month Exam	Control	91	3.57(.284)			6.21(.597)		
	Test	79	2.84(.271)	20.4	.06289	4.16(.403)	33.0	.00451
60 Month Exam	Control	79	4.43(.360)			8.24(.833)		
	Test	75	3.01(.249)	32.1	.00120	4.79(.437)	41.9	.00024

*Number in parenthesis is the standard error of the mean.

TABLE 5 REF 78

The use of a stannous fluoride dentifrice as an adjunct to topical application of Sn F2 and prophylaxis with Sn F2 paste has been shown to be even more beneficial for children both in fluoride and non fluoride areas.^{83, 84}

The "multiple fluoride therapy" was found to be effective in the reduction of dental caries in adult naval personnel by Scola and Ostrom after a two year study.⁸⁵ This report of benefit to adults was confirmed by Muhler et al⁸⁶ after a thirty month period of use.

SODIUM MONOFLUOROPHOSPHATE.

Accepted Dental Therapeutics⁴³ has listed a dentifrice containing 0.76 per cent sodium monofluorophosphate as an "A" classification. The studies by Fanning et al^{76, 77} reported a dentifrice containing this additive to be equally as effective in reducing caries as one containing stannous fluoride.

Naylor and Emslie⁸⁷, made a three year study of London School children in the 11 and 12 year age group. Their findings were equivalent to the Fanning study in Australia.

PROPHYLAXIS PASTES

The abrasive content of paste used for routine dental prophylaxis should serve dually to clean the teeth and to polish the exposed surfaces of the enamel, dentine and cementum. This can be equally said of the abrasive quality of a dentifrice, but the prophylaxis paste is less critical to tooth damage if the use is limited, as is usual, to two or three times a year.

The goal is to have an abrasive which will clean well with minimum damage to the teeth and produce a high lustre. Lava pumice and the finer flour of pumice are common constituents of prophylaxis pastes. A newer abrasive Zirconium Silicate was tested by Muhler⁸⁸ et al for its clinical effectiveness as a cleaning and polishing agent. Comparisons were made with flour of pumice and lava pumice in removing six different common forms of tooth stain. TABLE 8

TABLE 1

A Comparison of Flour of Pumice, Lava Pumice, and Zirconium Silicate for Their Ability to Remove the Various Type Enamel Stains Shown, Pellicle, or Stannous Fluoride Pigmentation

No. of Subjects	Type of Stain	No. with Stain, pellicle, or pigmentation	Flour of Pumice	Lava Pumice	Zirconium Silicate
			Number cleaned as function of abrasive		
544	Green	61	19	34	60
	Black	14	2	5	12
	Pellicle	48	41	42	48
	Yellow	14	10	10	14
	Brown	10	2	5	10
	SnF ₂	20	2	9	18
	None	377			

TABLE 8 REF-88

It has been stated that one of the major objectives of a good abrasive is to polish the enamel so well that it prevents the reformation of materia alba, pellicle, enamel stains and pigments. Similarly, if an abrasive produces a rough surface the reformation of deposits will be accelerated. TABLE 9 shows the results on 50 patients of five abrasives on pellicle reformation in the Muhler⁸⁸ study.

A Comparison of 5 Different Abrasives to Prevent Reformation of Pellicle Following a Thorough Prophylaxis with the Different Abrasives

<i>Abrasive</i>	<i>Days required for pellicle formation following prophylaxis with respective abrasives</i>
Flour of pumice	5
IMP/TCP	7
Tin Oxide	8
Levigated Alumina	17
ZrSiO ₄	31

TABLE 3

Reformation of Materia Alba Resulting from Overgrowth of Yeast (and/or Related Oral Organisms) Following a Thorough Prophylaxis With Either Flour of Pumice or ZrSiO₄

<i>Abrasive</i>	<i>Time</i>
Flour of Pumice	2.5 hours
ZrSiO ₄	86.0 hours

TABLE 9 REF-88

One case presented, in which the reformation of materia alba could be studied comparitively. The result Table 9 indicated a time difference in reformation on the smoother polished surfaces in the same mouth. Zirconium Silicate was found to achieve a high lustre and smoothness on amalgam restorations. The results in the study, taken collectively, indicated a possibility that reformation

of many substances on the enamel surface may be a function of cleanliness and smoothness.

A later study by Muhler and Stookey,⁸⁹ tested an improved Zirconium Silicate paste which incorporated 10 per cent tin oxide. The findings of this study were that the improved paste was 27.7 per cent more effective in enamel polishing than the paste containing Zirconium Silicate alone, and all other abrasives were much less effective than either of the Zirconium Silicate systems. Muhler stated that the incorporation of stannous fluoride into a prophylaxis paste using this system resulted in a significant reduction in dental caries^{83, 84}. Prophylaxis pastes containing 10 per cent stannous fluoride have been shown to be effective when used by a dentist or auxiliary in the dental surgery as part of a preventive programme, and in self application techniques as part of organised "brush ins".⁸⁵

DISCUSSION.

Dental caries has been established as a multifactorial chronic disease of man. Complete prevention of such a disease would be complex involving many diverse factors, oral hygiene is only one of the means available to the dentist and the individual for control of the disease.

The process of dental caries involves both the tooth and its environment. The literature reviewed in this section shows that the methods and procedures available for oral cleansing can be significantly effective if diligently applied.

The deposits which form on teeth, particularly dental plaque, provide an environment on the tooth surface conducive for the dental caries process to begin. The cleaning and polishing of these surfaces by oral hygiene procedures is an effective means of removing this prime environmental cause.

The agents available provide vehicles for the application to the tooth surfaces of fluoride compounds which increase the resistance of the tooth structure to dental caries. Although systemic ingestion of fluoride at optimal level is the most effective means of creating tooth enamel resistant to caries, it has been shown that topical applications in prophylaxis pastes, solutions and dentifrices achieve reductions in the incidence of dental caries in the teeth of individ-

uals from both fluoride and non fluoride areas. The concept of "multiple fluoride therapy" is now accepted as a preventive measure.¹²⁸

Derbyshire⁸⁹ describes oral hygiene as "a necessity if the health of the oral tissues is to be maintained or regained. It implies many times a lack of inner urge on the part of the patient to need or value effective hygiene and is a demand that the dental practitioner may rightfully make of a patient but only after the patient has been duly educated." It is only through education that a society which will be motivated to make effective use of the means of prevention at hand can be produced.

Oral hygiene procedures, tooth brushing and interproximal cleaning, have been shown to achieve reduction in the incidence of dental caries, when diligently used by an instructed individual in combination with a fluoride dentifrice. Optimal results are achieved when the preventive procedures are preceded by prophylaxis with a stannous fluoride paste and topical application of stannous fluoride. The most significant control in the incidence of dental caries has been shown when this regimen is applied by persons whose teeth have calcified and matured in an optimal fluoride area.

SECTION C

Oral Hygiene Procedures: For the
prevention and control of periodontal disease.

PERIODONTAL DISEASE.

HISTORICAL.

Diseases of the periodontal tissues have been known since ancient times. Alveolar bone loss, a sequela of the more severe forms of the disease, was prevalent in the jaws of Egyptian mummies of 4000 years ago. Icelandic skulls dating from A.D. 874-980 also have been found which display various stages of the disease³.

The first recognition of the removal of calcareous deposit as an important factor in the control of periodontal disease is credited to Abulcasis, an Arab in Spain in the late eleventh century.¹⁰

In France in the eighteenth century Pierre Fauchard's book "Le Chirurgien Dentiste" emphasised the need to keep the teeth clean if the disease were to be prevented.¹⁰ Chronic periodontitis was for a long time known as Fauchard's Disease.

The modern periodontology began in the second half of the last century. The most important figure was John Riggs. He was one of the first to recognise the importance of subgingival calculus in the causation of chronic periodontitis, and his method of treatment was essentially a most careful subgingival curettage, coupled with a careful polishing of the root surface. Riggs also insisted on methodical use of the tooth brush.

By the end of the 19th century the value of regular prophylaxis was recognised and was routinely practised.

The relationship between oral debris and deposits on the teeth and periodontal disease has been recognised for a long time, the adoption of preventive measures was of recent origin.

THE ETIOLOGY OF PERIODONTAL DISEASE.

A description of periodontal disease as given by Wolff and McMillan³ is as follows:

GINGIVITIS:

There is a gradual change from clinically normal gingiva to the early pathological state. Gingivitis is recognised by signs of inflammation which may be manifest by presence of one or more of the following: redness, swelling, bleeding, exudation and infrequently pain.

PERIODONTITIS.

This is an inflammatory disease of the gingiva and the deeper structures of the periodontium. The disease is considered to be a direct extension of gingivitis and is characterised by pocket formation and alveolar bone loss. Clinically, it is often difficult to distinguish between gingivitis and early periodontitis.

PERIODONTOSIS.

This is a degenerative disease which attacks the periodontal membrane and the alveolar bone. There are degenerative changes which occur in the periodontal ligament, interfering with cemental apposition. As a result, the fibres lose their attachment

to the teeth, their pull on the bone ceases and the bone resorbs. Inflammation and pocket formation are later symptoms of the disease. When these symptoms occur, the degenerative changes (periodontosis) may be overshadowed by the symptoms of periodontitis.

The inflammatory lesions affecting gingival units are caused by local factors which are similar to those causing inflammation in other tissues. These may be classified as follows:

1. Microbial.
2. Mechanical.
3. Chemical.
4. Radiant.

(Goldman and Cohen)⁹⁰

The direct relationship between plaque accumulation and gingivitis has been shown by Libé et al,⁹¹ who found that a group of twelve people with healthy gingiva developed decided accumulations of plaque, and clinically observable gingival inflammation when all oral hygiene measures were withdrawn. FIG 14. However, once oral hygiene measures were re-introduced the gingivitis subsided. Ash et al⁹⁵ reported similar findings.

Mandel²² reported that there was good reason to believe that bacteria play a major part in periodontal disease for the following reasons: (1) The pathogenicity of organisms from the gingival crevice can be demonstrated in the laboratory by injection of gingival debris subcutaneously into guinea pigs with the resultant development

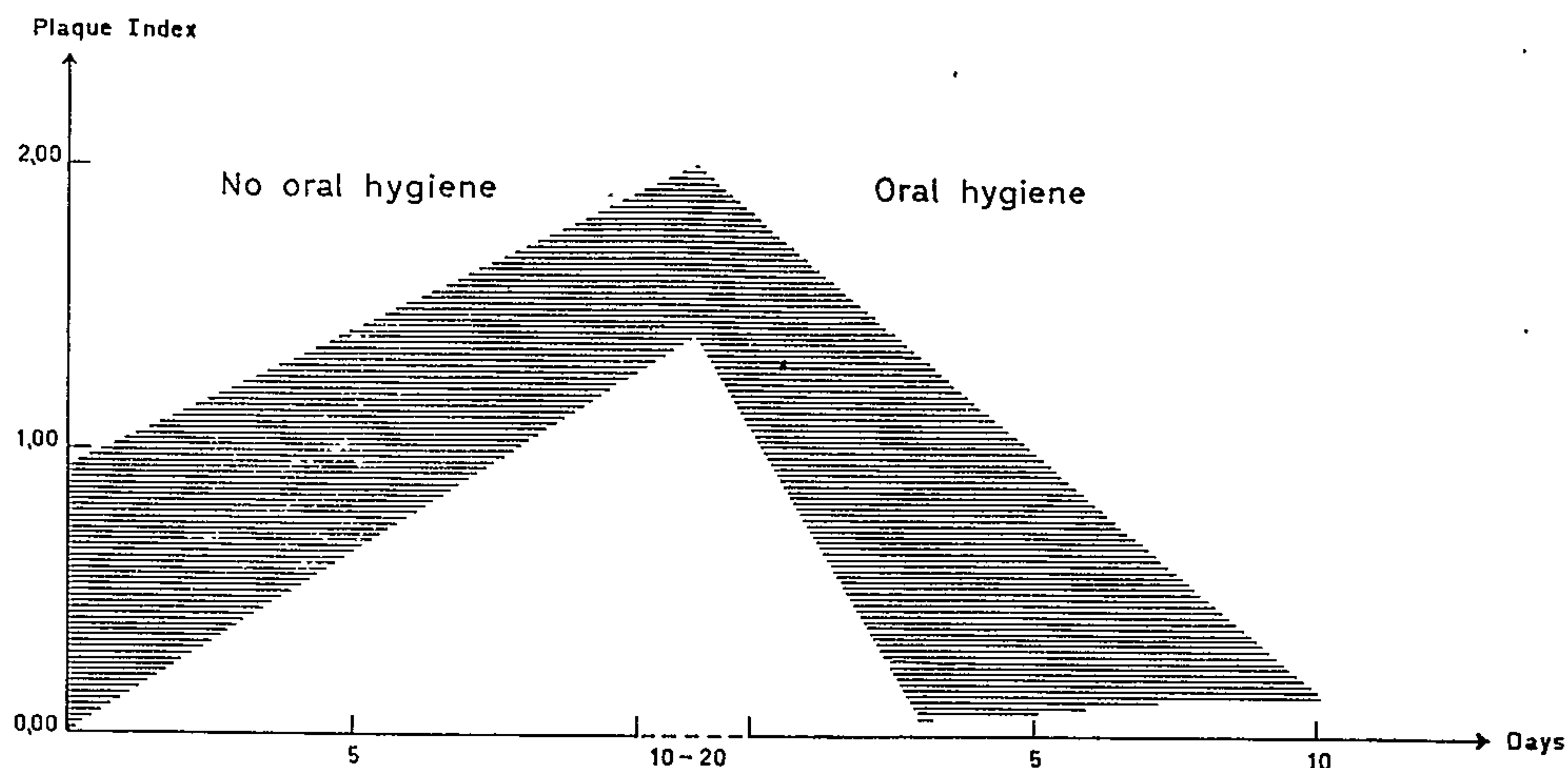


Fig. 2. Trends in the accumulation of soft debris during the periods of no oral hygiene and oral hygiene.

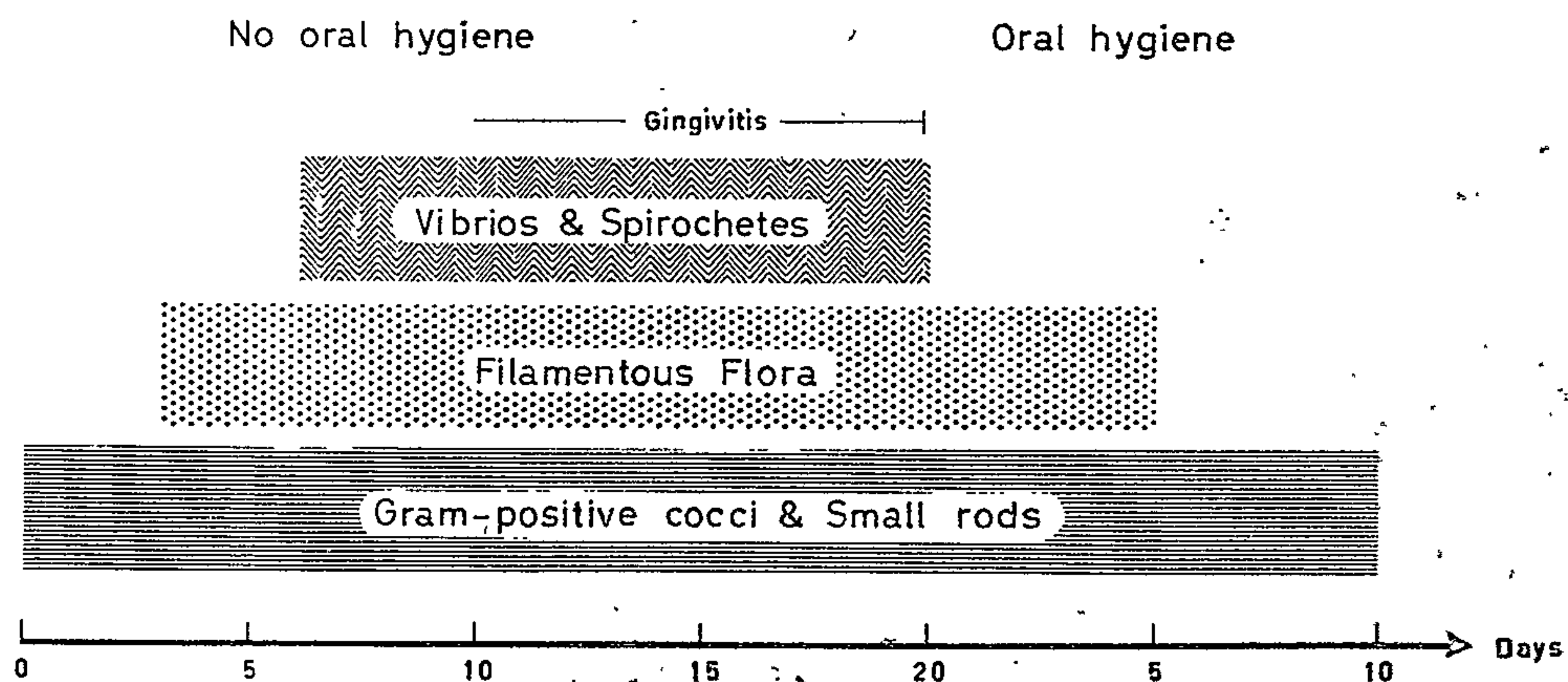


Fig. 3. Trends in the changes in the microflora of the gingival margin during the periods of no oral hygiene and oral hygiene.

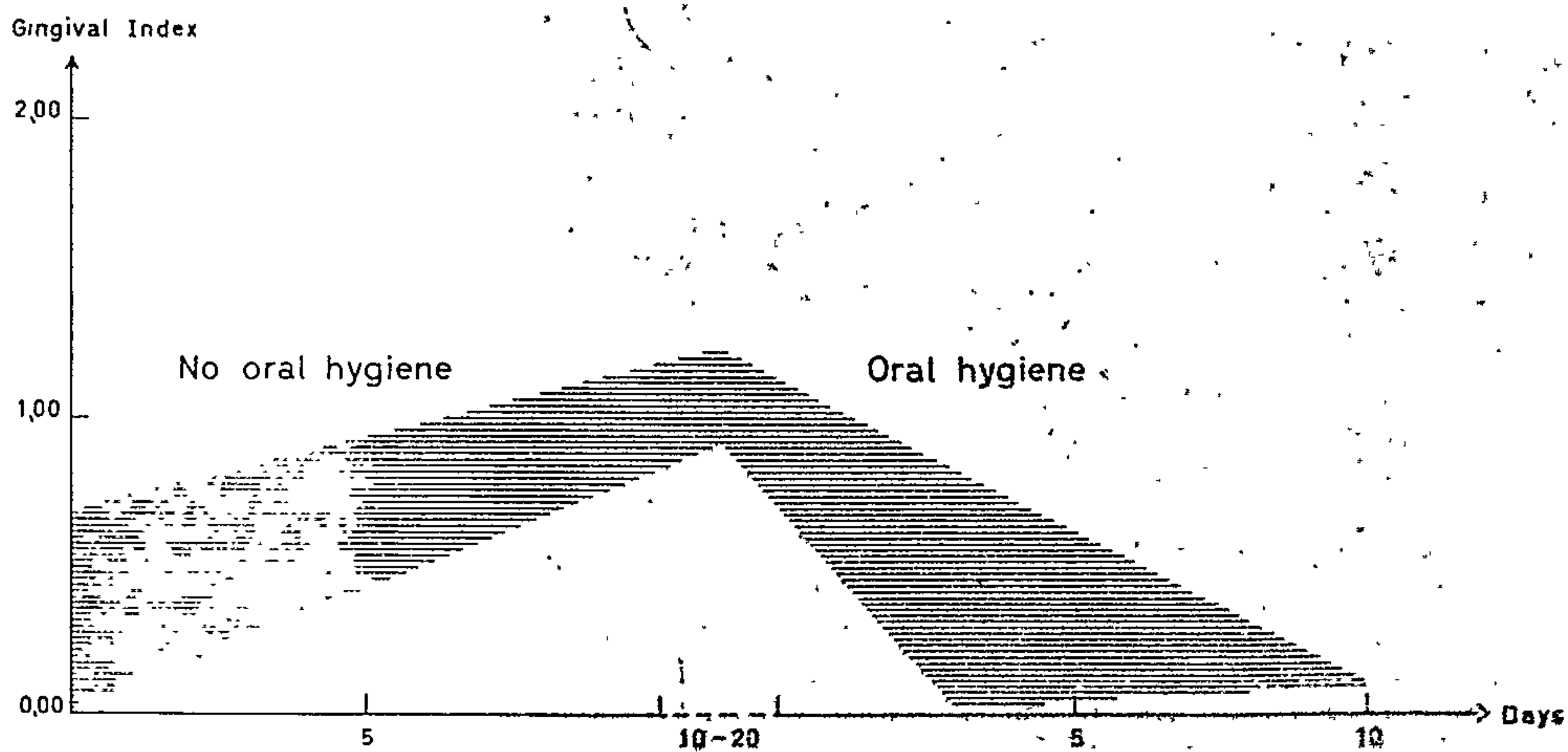


Fig. 4. Trends in the gingival changes during the periods of no oral hygiene and oral hygiene.

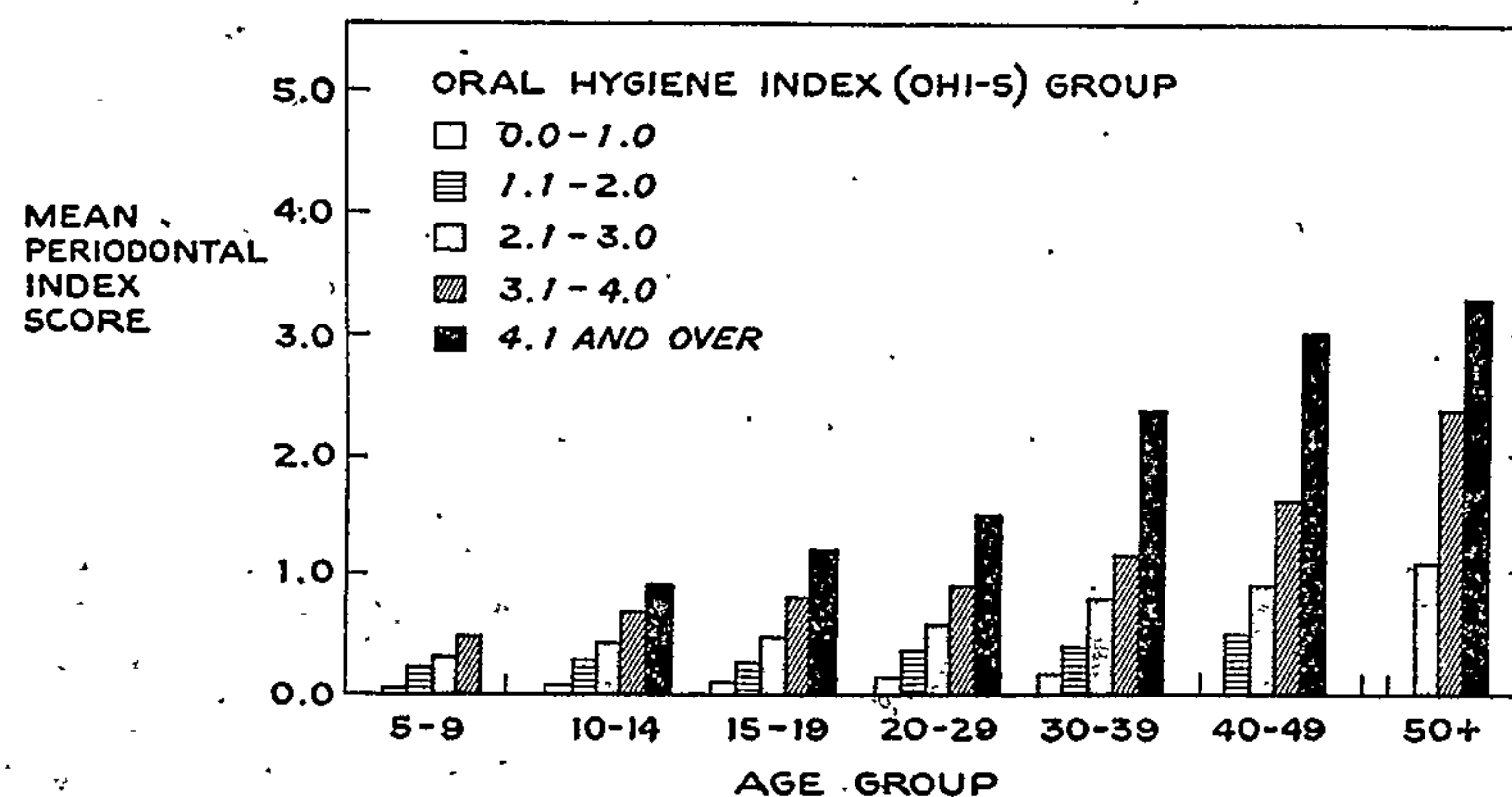
of abscesses. (2) Periodontal disease can be induced into uninfected hamsters by the injection of bacteria from plaques of hamsters in whom periodontal disease had occurred spontaneously. (3) Antibiotics can alleviate ulcerative gingivitis. (4) Antibiotics can reduce plaque formation without supportive oral hygiene. (5) Mechanical removal of plaque is effective in treating periodontal disease. (6) Refraining from brushing causes an increase in numbers of micro-organisms and progressive development of gingivitis.

Mandel²² expressed the opinion that there is no question that supra and subgingival calculi are major irritants to soft tissues. There was some question as to the manner of irritation. The presence of unmineralised bacteria on the surface of all calculi would suggest that the bacterial irritation would be primary and the mechanical factor secondary. In any event, the removal of the mineralised deposit and its microbial overlay would be a desirable procedure.

Waerhaug⁹² conducted experiments on the effect of rough surfaces on gingival tissue. He concluded that (1) Rough surfaces do not in themselves irritate the epithelial cells with which they come in contact. (2) The irritating effect of subgingival calculus is caused by bacteria or their toxins. (3) A rough surface facilitates the removal of bacterial plaque. (4) Restorations inserted below the gingival margin should be well polished.

Data FIG 15 TABLE 10 from examinations of 5,685 persons in studies by Greene⁹³ indicated that:

Figure 4—Mean Periodontal Index Scores by Age Group and Oral Hygiene Index Score Group for All Civilians Examined in Ecuador and Montana



Source—Table 7.

FIG 15 REF-93

Table 7—Mean Periodontal Index Scores by Age Group and Oral Hygiene Index Score Group for All Civilians Examined in Ecuador and Montana

Age Group	Mean Periodontal Index Scores (PI)						Number of Persons Examined					
	Oral Hygiene Index (OHI-S) Group						Oral Hygiene Index (OHI-S) Group					
	Total	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1 and over	Total	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1 and over
All ages							3,851	558	1,224	1,015	502	552
5- 9	0.21	0.05	0.21	0.29	0.47	*	1,072	225	481	328	36	2
10-14	0.33	0.06	0.23	0.40	0.65	0.90	1,247	185	474	390	149	49
15-19	0.46	0.09	0.23	0.46	0.79	1.20	422	66	132	115	66	43
20-29	0.80	0.12	0.32	0.64	0.89	1.48	424	52	73	87	102	110
30-39	1.40	0.14	0.33	0.73	1.18	2.38	316	21	40	52	78	125
40-49	2.12	*	0.45	0.87	1.58	3.04	164	5	15	22	35	87
50 and over	2.70	*	*	1.09	2.38	3.25	206	4	9	21	36	136

* Mean Periodontal Index score not calculated for fewer than ten cases.

TABLE 10 REF-93

(i) Periodontal Index⁴ scores increase with increasing age. Paralleling this is an increase in simplified Oral Hygiene Index⁵ scores.

(ii) Sex differences in the severity of periodontal disease disappear when persons of similar oral hygiene are compared.

(iii) Correlation coefficients show significant correlation of individual debris, calculus and OHI-S and PI scores.

(iv) Generally persons with good oral hygiene status - regardless of age - have low PI scores. Persons with very poor oral hygiene status - regardless of age - have high PI scores.

(v) Greater emphasis should be given in dental public health programmes to the improvement in oral hygiene as an important periodontal disease measure.

Lovdal et al¹⁰⁰ studied the clinical manifestations of periodontal disease in the light of oral hygiene and calculus formation in 1650 workers in Norway. Their conclusions were:

(i) The distribution pattern of gingivitis was similar to that of subgingival calculus.

(ii) A correlation exists between the efficiency of oral hygiene and the incidence and distribution of subgingival calculus, gingivitis, and pathologically deepened pockets.

(iii) The main manifestations are found interproximally - prevention should be directed to those areas.

The role of calculus FIG 16 in periodontal disease has been summarised by Mandel.²²



FIG 16 REF-55

Patient exhibiting heavy deposits of calculus and stain with alterations of gingival morphology.

Plaque control is the keystone of the prevention of gingival and periodontal disease. For the patient with a healthy periodontium plaque control means preservation of health, for the patient with periodontal disease it means optimal postoperative healing, and for the patient with treated periodontal disease plaque control means the prevention of recurrence of the disease.⁹⁴

TOOTHBRUSHING.

The most effective way for the individual to prevent the formation of plaque is the practised use of a toothbrush. As no brushing technique is able to reach all tooth surfaces the use of interproximal cleaning aids, unwaxed dental floss and interdental cleansers, are necessary to supplement the action of the brush.

The first step in the removal of dental plaque is in locating it. Oral debris and materia alba are clearly visible while plaque is not seen under normal conditions.¹⁴ Disclosing wafers or rinses are necessary to locate the plaque.³⁸ The use of disclosing agents serves not only to identify the location of the plaque but is an efficient method by which the person may evaluate the effectiveness of his oral hygiene programme.

The type of toothbrush and its recommended design have been discussed in the section on dental caries. The use of the small, soft, multitufted, flat profile brush has been accepted as being the most suitable for general usage.⁴⁴

Since 1960 there has been a great deal of interest in the comparison of electric and manual toothbrushes and their effectiveness in plaque removal and in maintaining gingival health. Ash⁹⁶ reviewed the problems and results of eight of these studies. TABLE 11. Ash concluded that there was insufficient evidence to show that automatic brushing was more effective than manual brushing for the average individual. He postulated that, although there was some

TABLE 8A
Results of Studies of Electric Toothbrushes

Ref.	Ref.	Subjects	No.	Criteria	Time	P	Results
57	35	Dental students	34	Plaque removal	Single brushing	.05	EB < R EA = R EA > EB
			36				EA = R
59	24	Dental students	37	Plaque removal	1 Week (repeat)	.05 .05 .05	EA > OB R = OB EA = R
97	18	Dental students	71	Plaque removal	1 Week (repeat)	.05 .10	EA > OB EA > R
				Gingivitis reduction		.05	EA = R
98	37	Dental students	15	Calculus prevention	4 Weeks	.01	EA > R
56	6, 7	Dental students	30	PMA; Cleanliness index	8 Weeks	.01	EB = R
98	4	Dental students	60	Debris removal	Single brushing (repeat)	.05	EB > R
99	42	College students	280	Gingivitis reduction	11 Weeks	.01	EA > R R > OB
59	24	Children 6-9 yrs. 10-12 yrs.	69 81	Plaque removal	Single brushing (repeat)	.01	EA > R EA > R

EA = Electric (GE)

EB = Electric (Broxodont)

OB = Old brush (routine home care)

R = Standard design, new brush

> = More effective

< = Less effective

P = Probability

TABLE 11 REF-96

conflicting evidence in the literature, on the relative efficiency for a particular type of patient the automatic brush was probably

more effective than the manual brush when used by a nurse or relative in the case of handicapped individuals. Also it could not be positively concluded that the automatic brush was more effective for children. Since training, interest, desire, and dexterity are interrelated in a complex manner, and because of a possible novelty effect further studies specially designed to evaluate the ease of use and ease of teaching would be necessary to demonstrate additional effectiveness of the automatic brush for children.

BRUSHING METHODS.

No specific method of tooth brushing has been accepted as a standard method. Some writers advocate one method but the concensus of opinion is that method must be carefully adapted to the particular need of the individual.^{47 49 50.} Goldman and Cohen³⁷ describe the Charter's method as being the most popular with periodontists since it would seem to be the most effective. However, they point out the following disadvantages. The bristle ends do not engage the gingival sulcus and hence do not dislodge submarginal deposits. Secondly, in some areas of the mouth, particularly the lingual aspects of the mandibular arch the brush cannot be angulated in the prescribed fashion because of anatomic restrictions. Thirdly, the requirements of digital dexterity are very high, so high, that few patients will continue to perform this method well over an extended period of time.

Their clinical experience has been that the most satisfactory results have been achieved by the instructed use of the Bass technique in periodontal practice.

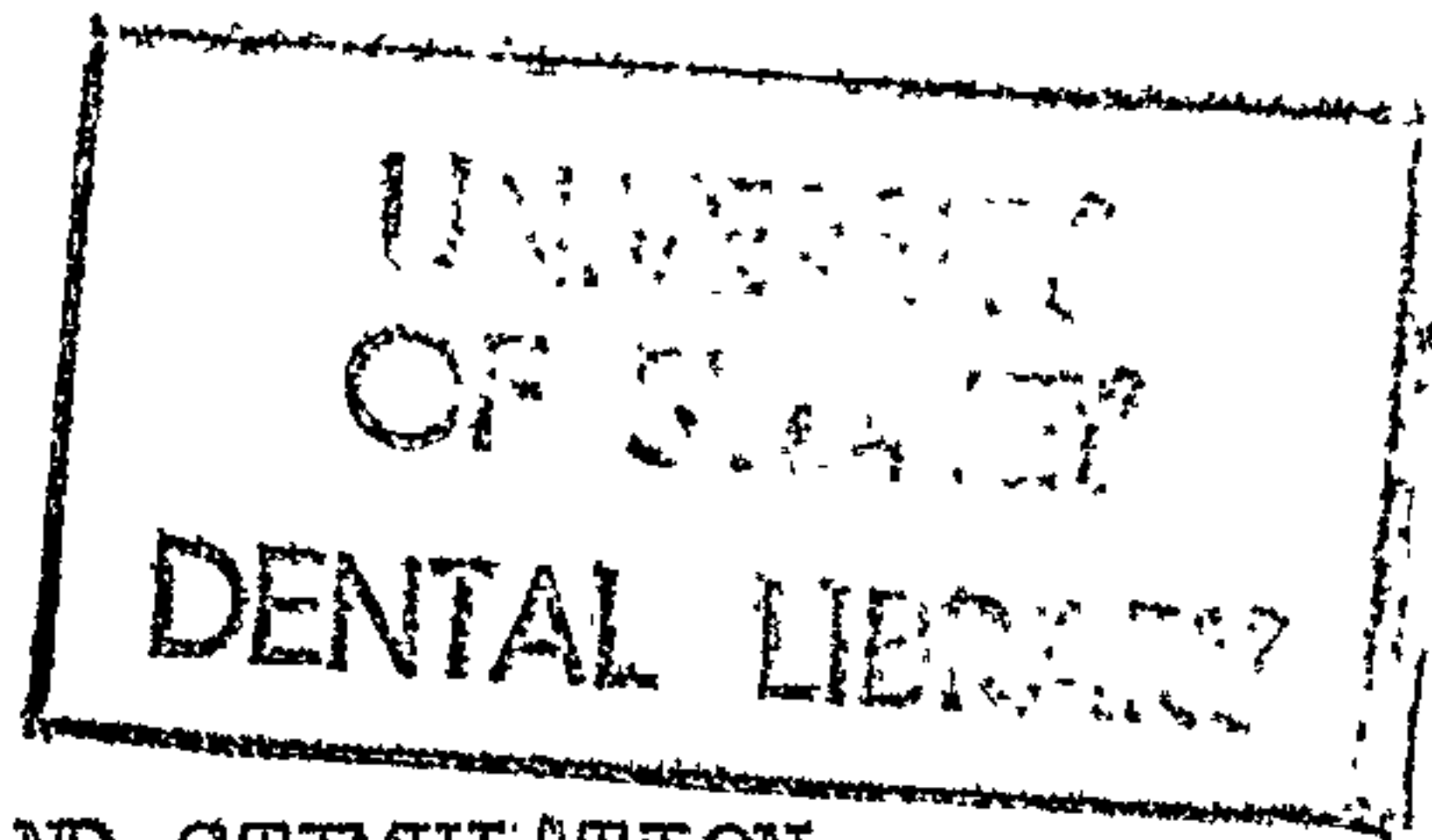
Derbyshire⁸⁹ is of the opinion that a brushing technique which will thoroughly remove plaque and debris, yet stimulate and not injure the soft tissues, is a personalised requirement which can only be developed by careful instruction and that the brush used must be modified as necessary to meet the requirements of the individual.

TABLE 12, from Steele,⁵⁵ presents a suggested table of oral cleansing procedures.

Although the manual tooth brush may require a greater expenditure of time than the average citizen is prepared to invest in his oral health it is nevertheless known to be effective when applied by a sufficiently motivated individual who has had the benefit of extensive personal instruction reinforced by periodic reviews.¹⁰¹

<i>Patient— Oral Condition</i>	<i>Toothbrushing Method</i>	<i>Supplementary Aids</i>
ALL PATIENTS	Present method if adequate; partial supplement if possible; new method if indicated	Mouth rinse (tap water) Disclosing agent
GINGIVA: normal, healthy TEETH: normal alignment, occlusion	Rolling Stroke	Dental floss or tape (if necessary, and if patient will follow instructions)
YOUNG CHILD or HANDICAPPED PATIENT who cannot control brush	Rolling Stroke if possible, otherwise Fones' or Leonard's	(Supervision and assistance by parent or attendant)
GINGIVA: mild recession or mild disturbance	Modified Stillman's, Bass' or combination	Dental floss or tape Interdental stimulator
GINGIVA: moderate to severe recession, loss of interdental papillae	Charters', Hirschfeld's, Modified Stillman's or combination; supplement with Rolling Stroke	Dental floss or tape Interdental stimulator Knitting yarn, pipe cleaner Hydrotherapy
FIXED PARTIAL DENTURE	Charters' (over appliance and abutment teeth)	Dental floss or tape Hydrotherapy
ORTHODONTIC BANDS and WIRES	Modified Stillman's, Bass', Rolling Stroke or combination	Hydrotherapy
REMOVABLE PARTIAL DENTURE or ORTHODONTIC RETAINER	Modified Stillman's, Bass'	Clasp brush Dental floss or tape Gauze strips Hydrotherapy Interdental stimulator Denture cleanser or regular dentifrice
COMPLETE REMOVABLE DENTURES		Denture brush Denture cleanser or regular dentifrice Digital massage

TABLE 12 REF-55



INTERDENTAL CLEANING AND STIMULATION.

Dental plaque cannot be completely removed by tooth brushing and dentifrice alone because the bristles do not reach the entire interproximal surface. Thorough removal of the interproximal plaque is essential because most gingival disease starts in the interproximal papillae and the incidence of the disease is highest there.^{24 63} For maximum plaque control it is necessary to supplement tooth brushing with other cleaning aids such as dental floss, interdental stimulators and cleaners, and in special cases hydrotherapy.

DENTAL FLOSS.

The use of unwaxed dental floss for the cleaning of the proximal surfaces of the teeth has been described in the section on dental caries. When used as a preventive aid for the control of periodontal disease care must be taken that the floss is not snapped past the contact point into the gingiva with such force as to produce injury. The principal purpose of dental floss is plaque removal, not to dislodge fibrous shreds of food wedged into the contact area and impacted into the gingiva. Food impaction should be treated by correcting contacts and plunger cusps and not be perpetuated by habitual flossing.

INTERDENTAL CLEANERS.

The use of rubber tips and balsa wood interdental cleaners are available for the individual to effectively clean the interproximal areas not reached by the tooth brush. There is little evidence

except for clinical impressions of the relative effectiveness of these agents. They have an advantage in that little chairside instruction time is required and can be used by the patient in almost any environment. The well motivated patient can clean the interproximal surfaces well with these aids. However, it is often difficult to reach the mesial and distal line angles of the teeth for plaque removal.⁶³

The action of the interdental tips, in addition to wiping the interproximal surfaces of the teeth, is to compress the interproximal tissue and provide stimulation in these constricted areas.

A study by Glickman and Petralis¹⁰² on the effect of interdental stimulators as an adjunct to toothbrushing found that the reduction in gingivitis was significantly greater at the one per cent level than that which followed toothbrushing alone.

HYDROTHERAPY

Water irrigation devices, consisting of a pump which forces a steady stream of pulsating water through a nozzle have now been developed to an extent that they are available for home use.

When used as a sole agent for oral hygiene the pulsed water jet has not been found to achieve significant reduction in stainable material on teeth. A study by Fine and Baumhammers¹¹³ in 1970 found only an 8.1 per cent reduction compared with 67.6 per cent with toothbrushing. They found no notable changes in microbial smears with either method when compared to the original.

The use of oral irrigation as an adjunct to tooth brushes and interproximal cleaning has been found to be a valuable aid, when used judiciously.^{64 65 66} The water jet does not detach plaque from the teeth but reduces the concentration of bacteria in the plaque.⁶⁴

Other studies have shown a reduction in materia alba formation¹¹⁴ and gingival inflammation.^{115 116}

The evaluation of the effectiveness of water irrigating devices for the treatment and control of periodontal disease is summarised by Goldman et al¹¹⁷ in the text Current Therapy in Dentistry. "The gingival sulcus and interdental col in the healthy mouth and the periodontal pockets in the diseased mouth provide an excellent environmental condition for the collection of bacteria

and debris. Even when the tooth brush and dental floss are diligently and regularly applied, it is unlikely that they can cleanse these areas consistently. This is especially true in case of faulty tooth anatomy or malaligned teeth or when the morphology of the interdental areas is further complicated by orthodontic bands or extensive restorative dentistry. The interdental area also presents a problem when, for various reasons, definite pocket elimination is contraindicated or when residual depth occurs following compromised procedures". The authors restrict the prescription of hydrotherapy to these conditions, finding it to be of particular advantage for the patient with multiple crowns and pontics. They regard irrigation as a therapeutic measure in the maintenance of the altered periodontium rather than a routine preventive measure, and do not advocate its use for the healthy uninvolved patient.

Therapists advise that a degree of caution should be exercised in use as extensive pressure or prolonged application in a limited area may cause tissue destruction. O'Leary⁶⁷ reported the possible formation of periodontal abscess from penetration of crevicular tissue by bacteria.

The prescribed use of hydrotherapy is a valuable oral cleaning aid for the patient who has received personal instruction. It acts as an adjunct to tooth brushing and interproximal cleaning. The open purchase of these devices without adequate instruction is to be condemned.³⁷

CHEMO-THERAPEUTIC AGENTS.

As plaque consists almost entirely of bacteria, attempts have been made to suppress the number of oral microorganisms and consequently the degree of plaque formation by medication. Several antibiotics have been tried. Mitchell and Holmes¹⁰³ found that a topically applied vancomycin ointment successfully inhibited the formation of plaque with a consequent reduction in gingivitis. They suggested that, as the plaque recurred so rapidly after the treatment period, there was a need for the development of some inexpensive simple method of application before vancomycin could be made available for general use. A mouth rinse containing an antimicrobial agent designated C.C 102 32 was tested by Stallard et al,¹⁰⁴ and found clinically to be most beneficial in the prevention and retardation of plaque, calculus and gingivitis when incorporated with a programme of adequate tooth brushing. The substance was of importance because it was not of use in general medicine, it was non toxic, and not absorbed orally or systemically. Volpe et al¹⁰⁵ in a continuation study found that the clinically significant statistical results increased after six and nine months use.

Recent advances in the chemistry of plaque have prompted the testing of enzymes theoretically capable of degrading the intermicrobial material. Laboratory experiments with dentranase,¹⁰⁶ mucinase¹⁰⁷ and hyaluronidase¹⁰⁸ have been shown to be promising. However, clinical tests have not been so encouraging. (Lindhe et al)¹⁰⁹

The use of antiseptic mouth rinses have long been advocated as adjuncts to oral hygiene principally by the manufacturers of commercial products. Their effectiveness as inhibitors of plaque and gingivitis formation have yet to be clinically established. Lindhe et al¹⁰⁹ reported a recent experiment by L  e and Schi  tt in which it was shown that the surfaces of all the teeth remained clean in a group of dental students who rinsed their mouths once a day with a 0.2 per cent solution of chlorohexidine (Hibitane^R) instead of brushing their teeth. The preliminary results of this pilot experiment were promising, but the prophylactic principle cannot yet be evaluated or used clinically until microbial problems and side effects, such as discolouration, tongue burning and loss of taste have been clarified. A study of the use of a mouthwash containing pyridinium chloride as an adjunct to tooth cleaning by Sturzenberger and Leonard¹¹⁰ produced inconclusive results as to its effectiveness in plaque control. The Council of Dental Therapeutics of the American Dental Association have not granted a classification to a proprietary mouthwash as a therapeutic aid for the prevention of gingivitis or periodontitis.

Other agents including compounds of urea,¹¹¹ and Vitamine C,¹¹² a catronic surface-active agent have been demonstrated to be capable of inhibiting the formation of plaque and calculus.

Even after the short range efficacy of any chemo-therapeutic agent has been proven, long term studies of effectiveness, possible

toxicity, and undesirable side reactions must be carried out before the agent can be made available for routine use. For the immediate future, plaque control must rest with mechanical means.⁶³

DENTIFRICES.

A dentifrice is a substance used with the tooth brush for the purpose of cleaning the teeth. The constituents of dentifrices have been discussed in the section on dental caries. There is no evidence to indicate that any one specific dentifrice is more effective than any other in the treatment, control, or prevention of periodontal disease.

The detergent and abrasive content of pastes aid in the removal of accumulated deposits on teeth when used in conjunction with the toothbrush. These deposits have been shown to be a prime cause of the development of periodontal disease. The acceptable taste additives to modern dentifrices are an encouragement to the individual to pursue regular oral hygiene procedures, thus acting as a means of motivation for their continued regular application.

Sensitivity of exposed tooth surfaces is a common problem for those patients whose periodontal disease has been intercepted by treatment. Any periodontal treatment procedure can be said to be doomed to failure if an oral hygiene regimen is not carried out effectively and regularly.³⁷ The use of special dentifrices to reduce this sensitivity and enable the treated patient to carry out the recommended procedures has been advocated. Ross¹¹⁸ investigated the use of a 10 per cent non releasing dentifrice containing strontium chloride in 78 patients suffering dental hypersensitivity. He found that 65 or 83.3 per cent obtained good to complete relief and only 5 per cent

failed to respond. The advantages of such a paste were stated as having no known contraindications and being readily available for home use from commercial sources.

Toto et al¹¹⁹ found a paste containing 1.4 per cent formalin to be a useful adjunct to periodontal therapy in that it controlled hypersensitivity.

The use of non-abrasive dentifrices is a useful adjunct to toothbrushing in the control of plaque and gingivitis. No specific therapeutic claims can be substantiated, but the alleviation of hypersensitivity by special pastes has been observed clinically.

DETERGENT FOODS.

It has been claimed that as most prepared food is soft it does not require much chewing and has little or no stimulating effect on the periodontal tissues and no cleansing effect on the teeth. Egelberg,¹²⁰ 1965, reported a close correlation between the consistency of the diet, the formation of plaque and the degree of gingivitis. When dogs received a soft diet, plaque and gingivitis soon occurred, but when the animals were given a hard diet, the amount of plaque and the signs of gingivitis rapidly decreased.

Studies in humans have not been able to demonstrate the same effect of the constituency of the diet on the amount of plaque formed. Lindhe et al¹²¹ studied prolonged chewing of fibrous food between meals for any effect on the development of plaque and gingivitis. A group of 18 male adults comprised the series. Their teeth were scaled and polished and each was given oral hygiene instruction. One week later the state of the gingiva and dental plaque were assessed for each member. The group then stopped brushing their teeth for 18 days. During this period nine of the group chewed raw carrots three times a day for three minutes under supervision. The degree of plaque and gingivitis was assessed on days 2, 7, 14 and 18. On none of these occasions was any difference found between the scores allotted to the experimental and the control group.

The difference between the results from the experiments in

dogs and in humans may be explained by the fact that the hard diet (bovine trachea) fed to the dogs was much harder than raw carrot and it was the sole component of the dogs diet; whereas the humans only chewed the carrot between meals. Also the dentition of the dog differs from that of man. The teeth are cone shaped and have free interproximal space between adjacent molars so that hard particles broken off during mastication can come in contact with the gingiva.¹⁰⁹

The results of a study by Arnim³⁸ using a quantitative method for measuring the stained deposits on teeth following the chewing of fibrous food showed no significant reduction in the bacterial deposits.

The chewing of detergent food cannot be regarded as an effective measure for the control of plaque in humans. Some benefit may be derived from the stimulating effect on the soft tissues and from the dispersement of soft accretions from the teeth.

ORAL PROPHYLAXIS.

Dictionaries are in agreement on the definition of prophylaxis as the prevention of disease. When the term is applied to the oral cavity, its definition becomes more complex. The broadest interpretation of oral prophylaxis includes all procedures performed in the oral cavity for prevention of disease. In its narrowest sense, oral prophylaxis is defined as a series of scaling and polishing procedures whereby deposits and stains are removed from the teeth for preventive purposes. This latter definition will be used in the discussion of those clinical procedures performed by the dentist and dental hygienist.

SCALING AND ROOT PLANING.

The terms scaling and root planing refer to those techniques which are used to remove calculus from the clinical crowns of teeth. Scaling techniques are used to remove supragingival and subgingival calculus that is attached to the tooth surface. Root planing techniques are used to remove the remaining pieces of subgingival calculus that are tenaciously adhered to the tooth and smooth root surfaces.¹²²

Many instructional texts have expressed a variety of opinions regarding instrument selection and methods of application. Certain basic principles apply to all methods, and once these principles are understood proficiency can be attained with

any instrument. These principles consist of a knowledge of anatomic, histologic, and physiologic characters of the teeth and the periodontium, as well as theories of calculus formation and attachment in order to understand the principles of instrument design and to develop operating skills.

Scaling and root planing instruments are designed for specific areas and use. No one instrument can be adapted to all surfaces of the teeth. A categorisation, according to their use, by Goldman and Cohen¹²³ is: chisels, curettes, files, hoes and sickles. The detailed instrumentation techniques are beyond the scope of this thesis. All techniques described require careful detection of calculus deposits, and the use of sharp instruments in a manner that does not traumatise the hard or soft tissues.

ULTRASONIC SCALING.

This is a method of dislodging and cleansing adherent accumulations from the tooth and root surfaces. With ultrasonic vibrations applied by appropriate instruments, it is possible to encourage the healing of periodontal lesions by producing clean even surfaces. Ultrasonic vibrations can scale, plane, rub and abrade teeth to free them of calculus, plaque, food debris, stain and softened cementum.

In periodontal instrumentation, a metal tip is inserted

into an ultrasonic handpiece and vibrated at a frequency of 25,000 times per second. When the tip is held against the calculus with very light pressure, the vibration fractures the deposit releasing it from the tooth surface. The vibration frequency is related to the size and weight of the tip. Heat produced by the vibration is dispelled by a continuous flow of water through the handpiece to the instrument tip. The water is dispersed from the tip in a spray of minute droplets which serve to flush out the gingival sulcus and remove pieces of broken calculus. A variety of different tips have been designed to provide access to various parts of the mouth. In contrast to hand scaling sharp instruments are unnecessary and undesirable. A dull tip lessens the potential for scratching or overplaning of the tooth surface in ultrasonic scaling.¹²²

The clinical and biological effects of the use of ultrasonic units were reviewed by Green and Sanderson.¹²⁴ The conclusions reached were that well trained and carefully supervised dental auxiliaries, as well as properly trained dentists, can safely use the ultrasonic unit for the rapid removal of supragingival calculus. The unit can remove gross deposits of calculus more quickly and efficiently than hand scalers and should be a

valuable addition to the periodontist's armamentarium.

Table 13 from Ewen and Glickstein¹²⁵ presents a comparison of ultrasonic and hand instrumentation.

TABLE II
COMPARISON OF ULTRASONIC AND HAND SCALING

<i>Ultrasonic</i>	<i>Hand</i>
Dull instruments	Sharp instruments
Able to remove heavy accumulations	Able to remove heavy accumulations
Able to plane off fine remnants	Able to plane off fine remnants
Knocks, hammers, planes, rubs	Scales and planes
Delivers a water coolant	Used dry
Flushes out crevices and cleans tissues immaculately	Incompletely removes crevicular debris and allows some impaction of calculus into soft tissue interstices
Coagulates soft tissue	No coagulation
Operates at high speed	Operates less rapidly
Good patient acceptance	Good patient acceptance
Sensitivity felt about linguals of lower anterior teeth	Some sensitivity
Heat delivered to tissues	No heat delivered to tissues
No wrist motion required, only smooth, even strokes	Wrist motion required
No fatigue factor in the operator	Manual fatigue definite after some time
Drugs of choice may be delivered to the tissues in depth	Drugs only applicable at the margins
Instrumentation produces shallow scratches	Instrumentation produces fairly deep scratches
Cavitation bubbles aid in debridement and serve as lubrication	No cavitation

CLEANING AND POLISHING.

Oral prophylaxis procedures include techniques for removal of all film, plaque, and extrinsic stains from the clinical crowns of teeth, and from fixed and removable appliances. A completely clean and smooth tooth surface inhibits the formation of new deposits and stains, which have etiological significance in the occurrence of periodontal disease.¹²² Waehaug⁹² found that rough surfaces themselves do not irritate the epithelial cells with which they come in contact. The irritating effect is from the bacteria and their toxins. A rough surface facilitates the retention of bacterial plaque. Therefore all tooth surfaces and restorations inserted below the gingival margin should be highly polished.

A recommended procedure for cleaning and polishing the teeth (Glickman)¹²⁶ is as follows:

1. After the removal of tooth deposits and obvious tenacious stains disclosing solution is applied to the teeth to reveal the location of mucinous plaques and surface stain. The stained areas are cleaned using a rubber cup and a paste of lava pumice or zirconium silicate. Areas inaccessible to the rubber cup are cleaned with wooden points, dental floss and pumice.

2. All tooth surfaces are then polished using a non-abrasive polishing paste, tin oxide or chalk. The surfaces of fixed

prostheses are polished and the surfaces of all restorations are checked, smoothed and polished.

3. Removable prostheses are cleaned and polished.

4. All the procedures must be carried out in a systematic fashion with extreme care and thoroughness. After the procedures have been completed, examination is carried out and the presence of dental caries and periodontal disease recorded. Dental caries inhibiting agents are applied at this stage.

5. The patient should be instructed in the technique of toothbrushing and interdental cleaning. The method employed by the patient should be checked and inadequacies corrected.

DISCUSSION.

At present no clinical methods are available for rendering the tooth surface unfavourable for plaque formation.

Owing to the anatomy of the dentition, a hard diet requiring prolonged chewing can reduce plaque formation and gingivitis in dogs. Chewing of fibrous foods between meals is not effective for the prevention of plaque formation or gingivitis in man.

Sucrose in the diet accelerates the production of extracellular polysaccharides, with extensive plaque formation promoting dental caries and periodontal disease. However, the general public do not appear likely to regard this as a risk sufficient to motivate restriction of sugar intake.

Experiments with antiseptics incorporated in mouthwashes have shown that it is possible to suppress the oral microflora to such an extent as to prevent plaque formation and thereby chronic gingivitis. However, this prophylactic principle has not been tried on a large group or have possible side effects been fully evaluated.

Thus at present, tooth brushing and other mechanical cleansing procedures are the only effective practical measures available for the prevention and control of dental plaque and thereby periodontal disease.

Motivational and barrier studies¹²⁷ have shown that an individual will not undertake a health measure unless he feels that the inconvenience encountered by performing this act would be less than the inconvenience he would encounter should he contract the disease. As these studies have also shown that many individuals

do not consider dental problems to be severe and they attach little importance to dental care, it can be understood why effective, but time consuming, oral hygiene procedures have not been widely accepted by the public.

Few of the current techniques, capable of producing satisfactory results, hold promise of markedly improving the oral health of a generally non motivated population.

A more acceptable effective and easily performed regimen is desirable. Any new method or modification of present techniques whereby satisfactory levels of oral hygiene could be more easily obtained without undue expenditures of patient time or effort, thus making oral hygiene procedures more acceptable to the general public. The eventual utilisation of such a technique would consist of its incorporation into programmes designed for mass application and directed towards the segments of society with the maximum need.

SUMMARY.

1. The literature relating to the various agents and procedures for oral hygiene purposes and their effectiveness for the prevention of dental disease has been reviewed.
2. Reduction in the incidence of dental caries can be achieved by motivated individuals who have been carefully instructed in a personal oral hygiene regimen incorporating the use of fluoride compounds.
3. The most significant results for caries control have been achieved by the application of "multiple fluoride therapy."
4. Plaque control is the keystone of the prevention of periodontal disease, mechanical cleansing by oral prophylaxis, tooth-brushing and interdental cleaning is the most effective method available at present.
5. The effectiveness of oral hygiene procedures for the mass of the population is limited by the lack of application of techniques which are time consuming and require regular instruction and review.

BIBLIOGRAPHY.

1. Pelton, W.J., Dunbar, J.B., McMillan, R.S., Moller, P.,
Wolff, A.E. - The epidemiology of oral health. Harvard
University Press, 1969.
2. Ibid. p. 1 - 14.
3. Ibid. p. 15 - 41.
4. Russel, A.L. - A system of classification and scoring for
preventive surveys of periodontal disease. J. dent. Res.,
35: 350 - 359, 1956.
5. Greene, J.C., Vermillion, J. R. - The oral hygiene index: a
method for classifying oral hygiene status. J. Am. dent.
Ass., 61: 172 - 179, 1960.
6. Brekus, P.J. - Dental disease and its relation to the loss of
human teeth. J. Am. dent. Ass., 16: 2237 - 2247, 1929.
7. Allen, E. F. - Statistical study of the primary causes of ex-
tractions. J. dent. Res., 23: 453 - 458, 1944.
8. Krough, H. W. - Permanent tooth mortality: a clinical study of
tooth loss. J. Am. dent. Ass., 57: 670 - 675, 1958.
9. Pelton, W.A., Pennell, E.A., Druzina, A. - Tooth morbidity
experience of adults. J. Am. dent. Ass., 49: 439 - 445, 1954.
10. Dunning, J. M. - Principles of dental public health - 2nd edition,
Harvard University Press, 1970. Chpt. 12.

11. Schwartz, R. S., Massler, M. - Tooth accumulated materials : A review and classification - J. Periodont., 40: 407 - 413, 1969.
12. Dawes, C. Jenkins, G. N., and Longe, C. H. - The nomenclature of the integuments of the enamel of teeth. Brit. dent. J., 115: 65 - 68, 1963.
13. World Health Organisation - Periodontal disease: Report of an expert committee on dental health. Int. dent. J., 11: 544 - 566, 1961.
14. Manly, R. S. - A structureless recurrent deposit on teeth. J. dent Res., 22 : 479 - 486, 1943.
15. Turner, E. P. - The integument of the enamel surface of the human tooth. 11. The acquired cuticle. Dent. Prac. (Bristol), 8: 373 - 382, 1958.
16. McDougall, W. A. - Studies on the dental plaque. I. The histology of the dental plaque and its attachment. Aust. dent. J., 8: 261 - 273, 1963.
17. Leach, S. A., and Saxton, C. A. - An electron microscopic study of the acquired pellicle and plaque formed on the enamel of human incisors. Arch. oral Biol. 11: 1081 - 1094, 1966.
18. Vallotton, C. F. - An acquired pellicle of the enamel surface II. Clinical and histological studies. J. dent. Res. 24: 171 - 182, 1945.

19. Millin, D.J., and Smith, M. H. - nature and composition of dental plaque. *Nature*, 189: 664 - 665, 1964.
20. Meckel, A. H. - The formation and properties of organic films on teeth. *Arch oral Biol.*, 10: 585 - 597, 1965.
21. McDougall, W. A. - Studies on the dental plaque. II. The histology of developing interproximal plaque. *Aust. dent. J.*, 8: 398 - 407, 1963.
22. Mandel, I. D. - Dental plaque: Nature, formation and effects. *J. Periodont.*, 37: 357 - 367, 1966.
23. Winkler, K. C., and Dirks, O.B. - The mechanism of the dental plaque. *Int. dent. J.*, 8: 561 - 585, 1958.
24. Bjorn, H., and Carlson, J. - Observations on a dental plaque morphogenesis. *O dont. Revy.*, 15: 23 - 28, 1964.
25. Mandel, I. D., Levy, B. M., and Wasserman, B. H. - Histochemistry of calculus formation. *J. Periodont.*, 28: 132 - 137, 1957.
26. Baer, P.N., and Newton, W. - The occurrence of periodontal disease in germ free mice. *J. dent. Res.*, 38: 1238, 1959.
27. Theilade, J., and Schroeder, H. E. - Recent results in dental calculus research. *Int. dent. J.*, 16: 205 - 221, 1966.
28. Bremner, M. D. K. - The story of dentistry. *Dental Items of Interest Publishing Co.*, 1939. p.3

29. Bernier and Muhler, editors - Improving dental practice through preventive measures. 2nd edition, C. V. Mosby, St. Louis, 1970. Chapt. 4.
30. Greenby, T. H. - The effect of some carbohydrates on experimental dental caries in the rat. Arch. oral Biol., 8: 27 - 30, 1968.
31. Greenby, T. H. - white and wholemeal bread and flour in the diet of caries susceptible rats. Brit. dent. J., 121: 26 - 29, 1963.
32. Krasse, B. - The effect of caries inducing streptococci in hamsters fed diets with sucrose or glucose. Arch. oral Biol., 10: 223 - 226, 1965.
33. Critchly, P., Saxton, C. A., Kalendo, A. B. - The histology and biochemistry of dental plaque. Caries Res., 2: 115 - 129, 1959.
34. Carlsson, J., and Egelberg, T. - The effect of diet on early plaque formation in man. Odont. Revy., 16: 112 - 125, 1965.
35. Craig, G. G., and Dunn, G. R. - A guide to the practice of preventive dentistry. Dental Health Education and Research Foundation, Univ. of Syd., 1971. p.8.
36. Sogmaes, R. F., editor - Chemistry and prevention of dental caries. Charles C. Thomas publisher 1962 p. 164.

37. Goldman and Cohen, editors - Periodontal Therapy. C. V. Mosby, St. Louis, 1968. Chap. 18.
38. Arnim, S. S. - The use of disclosing agents for measuring tooth cleanliness. J. Periodont., 34: 227 - 243, 1963.
39. The Broxodent Electric Toothbrush - Descriptive Manual Part I.
40. Addis, R. - History of the toothbrush Brit. dent. J., 66: 532, 1939.
41. McCauley, H. B. - Toothbrushes, toothbrush materials and design. J. Am. dent Ass., 33: 283 - 293, 1946.
42. American Dental Association - Council Statement - Manual toothbrushes not obsolete. J. Am. dent Ass., 68: 279, 1964.
43. Accepted Dental Therapeutics - Toothbrushes. Am. dent. Ass. 34th edition, 1971/72. p.239.
44. Fanning, Elizabeth A., Henning, F. R. - Toothbrush design and oral health. Aust. dent. J., 12: 464 - 467, 1967.
45. Bass, C. C. - The optimal characteristics of tooth brushes for personal oral hygiene. Dental Items of Interest 70: 291. 1948.
46. Roth, H. Thaller, J. Alderman, N. E. - Charter's method of toothbrushing massage. J. Periodont. 27: 309, 1956.
47. Robinson, H. B. G. - Toothbrushing habits of 405 persons. J. Am. dent Ass. 33: 1112, 1946.

48. Charters, W. J. - Home care of the mouth. J. Periodont, 19: 136, 1948.
49. Hine, M. K. - Use of the tooth brush in treatment of periodontitis. J. Am. dent. Ass., 158 - 169, 1950.
50. Curtis, G. H., McCall, C. M., and Overua, H. J. - A clinical study of the effectiveness on the Roll and Charter's methods of brushing teeth. J. Periodont., 28: 277, 1957.
51. Fosdick, L. S. - The reduction of the incidence of dental caries, II. Immediate tooth brushing with a neutral dentifrice. J. Am. dent. Ass., 40: 133 - 143, 1950.
52. Hein, J. H. - A study of the effect of frequency of tooth brushing on oral health. J. dent Res., 33: 708, 1964.
53. McClure, D. B. - A comparison of toothbrushing techniques for the pre-school child. J. dent. (Child., 33: 205, 1966.
54. Rodda, J. C. - A comparison of four methods of tooth brushing. N.Z. dent. J., 64: 162 - 167, 1968.
55. Steele, P. F. editor - Dimensions of dental hygiene. Lea and Febier. Philadelphia, 1966. Chpt. 3.
56. Chilton, N. W., Didio, A., and Rothner, J. T. - Comparison of the clinical effectiveness of an electric and a standard tooth brush in normal individuals. J. Am. dent. Ass., 64: 777 - 782, 1962.
57. Quigley, G. A., Hein, J. W. - Comparative cleansing efficiency of manual and power brushing. J. Am. dent. Ass. 65: 26 - 29, 1962.

58. Panaeuf, E. A., Harrington, J. H., Dale, P. P., and Sklar, G. - Automatic tooth brush: a new reciprocating action. J. Am. dent. Ass., 65: 12 - 25, 1962.
59. Leptowitch, W., and Robinson, H. B. G. - Effectiveness of automatic and hand tooth brushes in removing dental plaque and debris. J. Am. dent Ass. 65: 351 - 361, 1962.
60. Vowles, J. K. - Assessment of an automatic action tooth brush (Broxodent) in spastic children. Brit. dent. J., 115: 327 - 329, 1963.
61. Smith, J. F. Blakenship, J. - Improving oral hygiene in handicapped children by the use of an electric tooth brush. J. dent. Child., 31: 198 - 203, 1964.
62. Bass, C. C. - The optimal characteristics of dental floss for personal oral hygiene. Dental Items of Interest, 70: 921, 1948.
63. O'Leary, T. J. - Oral hygiene agents and procedures, J. Periodont., 41: 625 - 629, 1970.
64. Hoover, D. R., Robinson, H. B. G. Billingsley, A. - The comparative effectiveness of the Water-Pik in a non instructed population. J. Periodont., 39: 43, 1968.
65. Lobene, R. - The effect of pulsed water jet pressure cleansing devices on oral health. J. Periodont. 40: 667, 1969.
66. Toto, P.W., Evans, C. L. Sawinski, V. T. - Effects of water jet rinse and tooth brushing on oral hygiene. J. Periodont. 40: 296 - 298, 1968.

67. O'Leary, T. J., Schafer, W. G. Swenson, H. M. Nessler, D. C.
Van Dorn, P. R. ? Possible penetration of crevicular tissue
from oral hygiene procedures. I. Use of oral irrigating
devices. J. Periodont., 41: 158, 1970.
68. Knighton H. J. - Effect of various foods and cleansing agents
on elimination of artificially inoculated yeast from the
mouth. J. Am. dent. Ass. 29: 2012 - 2018, 1942.
69. Caldwell, R. C. - Physical properties on foods and their caries
producing potential. J. dent Res., 49: 1293 - 1299, 1970.
70. Ware, A. L., Chong, J. L. - A review of dentifrices as thera-
peutic agents. Aust. dent. J., 9: 203 - 207, 1964.
71. Kitchen, P. C., and Robinson, H. B. G. - How abrasive need a
dentifrice be? J. dent Res., 27: 501 - 506, 1948.
72. Slack, G. L. - The claims of therapeutic dentifrices. Brit.
dent. J., 104: 83 - 88, 1958.
73. Fosdick, L. S. - Clinical experiment on the use of sodium N -
lauroyl sarcosinate in control of dental caries. Science
123: 988, 1956.
74. Council on Dental Therapeutics., Am. dent Ass., - Reclass-
ification of Crest. J. Am. dent. Ass. 69: 195, 1964.
75. Council on Dental Therapeutics., Am. dent. Ass. - Evaluation
of Cue. J. Am. dent. Ass. 69: 197, 1964.
76. Fanning, Elizabeth A., Gotzamanos, T., Vowles, N. T. - The
use of fluoride dentifrices in the control of dental
caries:

76. (cont) Methodology and results of a clinical trial. Aust. dent. J. 13: 201 - 206, 1968.
77. Fanning, Elizabeth A., Cellier, K. M. Gotjamanos, T., Vowels, N. J. - The effect of fluoride dentifrices on the caries incidence on individual tooth surfaces. Aust. dent. J., 16: 287 - 290, 1971.
78. Gish, C. W. Muhler, J. C. - Effectiveness of stannous fluoride dentifrice on dental caries. J. dent. Child. 3: 75 - 78, 1971.
79. Gish, C. W., Muhler, J. C., Stookey, G. K. - Effectiveness of $\text{Sn F}_2 - \text{Ca}_2 \text{P}_2 \text{O}_7$ dentifrice on dental caries in children whose teeth calcified in a natural fluoride area. I Results at the end of 12 months. J. Am. dent. Ass., 71: 60 - 65, 1965.
80. Gish, C. W., Muhler, J. C., Effectiveness of $\text{S}_n \text{F}_2 \text{Ca}_2 \text{P}_2 \text{O}_7$ dentifrice on dental caries in children whose teeth calcified in a natural fluoride area. 11. Results at the end of 24 months. J. Am. dent Ass., 73, 853 - 855, 1966.
81. Muhler, J. C. - Effect of a stannous fluoride dentifrice on caries reduction during a three year study period. J. Am. dent. Ass. 64: 216, 1962.
82. Jordan, W. A., Petersen, J. K. - Caries inhibiting value of a dentifrice containing stannous fluoride, final report of a two year study. J. Am. dent Ass. 58: 42, 1961.

83. Gish, C. W., Muhler, J. C. - Effects on dental caries in children in a natural fluoride area of combined use of three agents containing stannous fluoride: a prophylactic paste, a solution and a dentifrice. J. Am. dent. Ass. 70: 914 - 920, 1965.
84. Bixler, W., Muhler, J. C. - Effects on dental caries in children in a non-fluoride area of combined use of three agents containing stannous fluoride: a prophylactic paste, a solution and a dentifrice. J. Am. dent. Ass., 72: 792 - 800, 1966.
85. Scola, F. P., Ostrom, C. A. - Clinical evaluation of stannous fluoride when used as a constituent of a compatible prophylactic paste, as a topical solution, and in a dentifrice in naval personnel. II Report after two years. J. Am. dent. Ass., 77: 594 - 597, 1968.
86. Muhler, J. C., Spear, L. B., Bixler, D., Stookey, G. K. - The assessment of incipient dental caries in adults after the use of three different forms of $S_n F_2$ therapy: results after 30 months. J. Am. dent. Ass., 75: 1402 - 1406, 1967.
87. Naylor, M. N., Emslie, R. D. - Clinical testing of stannous fluoride and monofluorophosphate dentifrices in London school children. Brit. dent. J., 123 : 17 - 23, 1967.
88. Muhler, J. C., Dudding, Nancy T., Stookey, G. K. - The clinical effectiveness of a particular particle size distribution of zirconium silicate for use as a cleaning and polishing agent for oral hard tissues. J. Periodont., 35: 481 - 485, 1964

89. Derbyshire, J. C. - Methods of achieving effective mouth hygiene. - The Dental Clinics of North America. March, 1964, p.231.
90. Goldman, H. M., Cohen, W. D., editors - Periodontal Therapy. C. V. Mosby Co., 1968 pp 209 - 260.
91. Loe, H., Theilade, E., Jensen, S. B. - Experimental gingivitis in man. J. periodont 36: 177 - 187, 1965.
92. Waerhaug, J. - Effect of rough surfaces on gingival tissues. Arch. oral, Biol. 35: 323 - 325, 1965.
93. Greene, J. C. ? Oral hygiene and periodontal disease. A study of 5, 865 persons in Ecuador and Montana. Am. J. Pub. Health, 53: 913 - 922, 1963.
94. Bernier and Muhler, editors - Improving dental practice through preventive measures. 2nd edition, C. V. Mosby, St. Louis, 1970. Chap. 9.
95. Ash M. M., Gitlen, B. N., and Smith, W. A. - correlation between plaque and gingivitis. J. Periodont., 35: 424, 1964.
96. Ash, M. J. - A review of the problems and the results of studies on manual and power tooth brushes. J. Periodont. 35: 202 - 213, 1964.
97. Hoover, D. R., Robinson, H. B. G. - Effect of automatic and hand brushing on gingivitis. J. Am. dent. Ass. 65: 361, 1962.
98. Ramfjord, S. - Indices for prevalence and incidence of periodontal disease. J. Periodont. 33: 386, 1962.

98. (Cont) Birch, R. H., Mumford, J. M. - Electric tooth brushing.
Dent. prac. dent. Rec. 13: 183, 1963.
99. Soparkar, P. M., Quigley, G. A. - A comparative study of gingivitis with manual and power brushing. I.A.D.R. Abs., Mar. 1963.
100. Lovdal, A., Arno, A., Waerhung, J. - Incidence of clinical manifestations of periodontal disease in the light of oral hygiene and calculus formation. J. Am. dent. Ass. 52: 21 - 23, 1958.
101. Kimery, M. J. Stallard, R. E. - The evolutionary development and contemporary utilisation of various oral hygiene procedures.
Periodontal. Abs. 19: 90 - 97, 1968.
102. Glickman, I., Petrolis, R., Marks, R. M. - The effect of powered toothbrushing plus interdental stimulation upon the severity of gingivitis. J. Periodont. 35: 519, 1964.
103. Mitchell, D. F., Holmes, L. A. - Topical anti-biotic control of gingival plaque. J. Periodont. 36: 202 - 207, 1965.
104. Stallard, R. E., Volpe, A. R., Orban, J. E., King, W. T. - The effect of an antimicrobial mouth rinse on dental plaque, calculus and gingivitis. J. Periodont. 40: 683 - 694, 1969.
105. Volpe, A. R., Schulman, S. M., Goldman, H. M., King, W. J., Kupizak, L. J. - The long term effect of an antimicrobial formulation on calculus formation. J. Periodont. 41: 463 - 468, 1970.
106. Fitzgerald, R. J. Keyes, P. H. Standt, Th. H., Spinnel, D. M. - The effects of a dentranose preparation on plaque and caries in hamsters, a preliminary report. J. Am. dent. Ass. 76: 301 - 304, 1968.

107. Aleece, A. A. Forscher, B. K. - Calculus reduction with a mucinase dentifrice. J. Periodont. 25: 122, 1954.
108. Wasserman, B. H., Mandel, I. D., Levy, B. M. - In vitro calcification of dental calculus. J. Periodont. 29: 144, 1958.
109. Lindhe, J., Lungren, D., Nyman, S. - Considerations on prevention of periodontal disease. Periodontal. abs. 18: 50 - 57, 1970.
110. Sturzenburger, O. P., Leonard, G. T. - The effect of a mouthwash as an adjunct in tooth cleaning. J. Periodont. 40: 299 - 301, 1969.
111. Belting, C. M., Gordon, D. L. - In vivo effect of a urea containing dentifrice on dental calculus formation. J. Periodont. 37: 27, 1966.
112. Turskey, S., Gilmore, N. D., Glickman, I. - Reduced plaque formation by the chloromethyl analogue of Vitamine C. J. Periodont. 41: 41 - 43, 1970.
113. Fine, D. H., Baumhamsers, A. - Effect of water pressure irrigation on stainable material on teeth. J. Periodont. 41: 468 - 471, 1970.
114. Lobene, R. R. - The effect of a pulsed water pressure cleansing device on oral health. J. Periodont. 40: 667 - 670, 1969.

115. Cantor, J. M. T., Stahl, S. S. - Intercol tissue responses to the use of a water pressure cleansing device. J. Periodont. 40: 292, 1969.
116. Krajewski, T., Giblen, J. Gargulio, A. W. J. - Evaluation of a water pressure cleaning device as an adjunct to periodontal treatment. Periodontics 2: 76, 1964.
117. Goldman, H. M., Forrest, S. F., Byrd, D. L. McDonald, R. E. Current Therapy in Dentistry, Vol II. C. V. Mosby, St. Louis, 1966. p.60.
118. Ross, M. P. - Effect of strontium chloride in a compatable dentifrice on hypersensitive teeth. J. Periodont. 32: 49, 1961.
119. Toto, P. D., Staffileno, H., Gargiulo, A. W. - A clinical evaluation of a desensitising tooth paste. J. Periodont. 29: 192, 1958.
120. Egelberg, J. - Local effect of diet on plaque formation and development in dogs. I., effect of hard and soft diets. Odont. Revy., 16: 31, 1965.
121. Lindhe, J., Wicén, P. O. - The effects on gingiva of chewing fibrous foods. Periodontal. Abs 17: 186, 1969.
122. Steele, P. F. - Dimensions of dental hygiene. Lea and Febier, Philadelphia, 1966. Chpt. 4.
124. Green, G. H., Sanderson, A. W. - Ultrasonics in periodontal therapy. A review of clinical and biological effects. J. Periodont. 36: 232, 237, 1965.

125. Ewen, S. J., Glickstein, C. - Ultrasonic therapy in periodontics, Thomas C. C., publisher, 1968. p.45.
126. Glickman, I., editor - Clinical periodontology, W. B., Saunders, Philadelphia, 1958. Chpt. 48.
127. Kegeles, S. S. - Why people seek dental care: a review of present knowledge. Am. J. Pub. Health. 51: 1306, 1961.
128. Muhler, J. C. - A practical method for reducing dental caries in children not receiving the established benefits of communal fluoridation. J. dent. Child., 29: 5 - 12, 1961.