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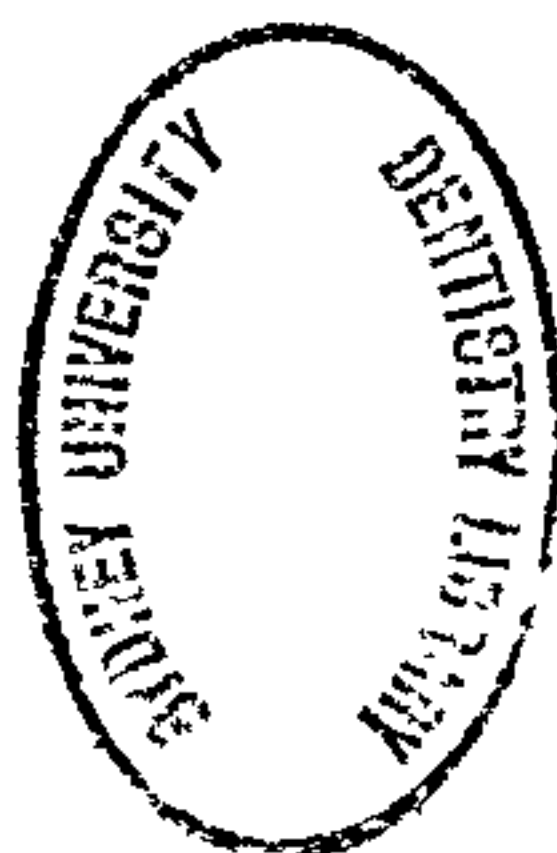
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A REVIEW
OF
SOME ORTHODONTIC PROBLEMS IN ASSOCIATION WITH THE PREVENTION
AND TREATMENT OF MALOCCLUSION IN A COMMUNITY

A thesis submitted in the Faculty of Dentistry
in partial fulfillment of the requirements for
the Diploma in Public Health Dentistry at the
University of Sydney.

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December 1963.



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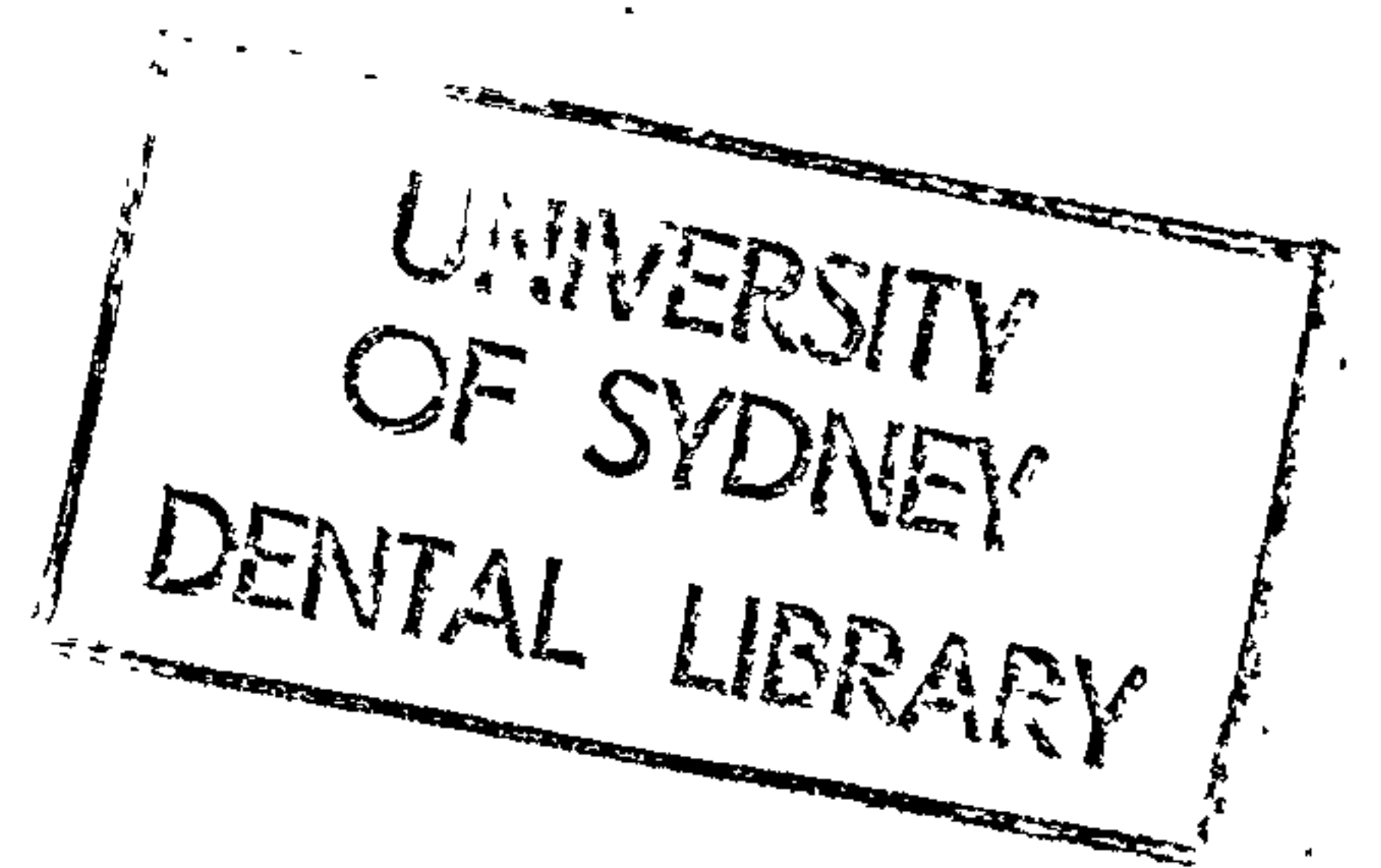
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PREFACE

It is intended to present a general review of some of the orthodontic problems regarding the prevention and treatment of malocclusion at the community level.

The nature of the review will not be specific and discussions will run on a series of inter-related topics which would bear direct or indirect influences on the aspects of prevention of malocclusion and the provision of orthodontic services and manpower in the community.

It is the purpose of this review to unfold the complexity of some of the problems confronting the dental profession, and also to suggest certain principles of action to follow as part of the solution to these problems.

In this review, no attempt is made to bring out a central theme, thus avoiding the possible misunderstanding that one solution might be suggested as being better than the rest; this is not intended.

However, there is a general tendency throughout the contents to lay emphasis on the need for a profound understanding of the nature of malocclusion and the need to pay a high respect for some fundamental orthodontic principles and biological laws rather than to slavishly make use of some specific appliances.

It is suggested that this review could be looked upon

as to consist of three major areas of discussion.

The first portion, consisting of the first six chapters, is to bring out the intrinsic basic problems of malocclusion itself, such as the difficulties of pinpointing and defining malocclusion and its etiologic factors, classification, and occlusal indices.

In an attempt to evaluate different forms of orthodontic services and treatment approaches as regards the aim and extent of treatment, the European countries and the United States; the second portion, consisting of Chapters 7, 8 and 9, discusses the relative merits of various diverse forms of orthodontic services in these continents and also mentions the advantages and disadvantages of removable and fixed appliances.

The last and third major area of the review stresses the importance of disciplined orthodontic education as the only salvation to amend the present acute shortage of man-power in the orthodontic team which consists not only of specialists but also general practitioners. The latter, however, are expected to take up the main bulk of work in preventive and interceptive orthodontics, leaving the specialist time to concentrate on major corrective orthodontic work. It is expected that general practitioners would and could contribute a great deal in the orthodontic team if they had the proper training, and this could only come from a systematic and disciplined training before and after their graduation from dental schools.

This brief introduction has greatly over-simplified the contents of materials. Nevertheless, it is hoped that the brevity might help the interested reader to pick up the trend of thought and to follow on his own searching in and outside the actual contents of this review.

CHAPTER 1. INTRODUCTION TO SOME TERMS

The terms 'malocclusion' and 'dentofacial deformity' are often, though mistakenly, interchanged to mean similar things. The term 'dentofacial deformity' is used to denote all deviations from the expected and desired pattern of development of the dentition and facial complex (38). Malocclusion is limited in its definition, and refers only to 'deviations from the desired form of occlusion' (38). It is strictly a dental term, and denotes a malrelationship of the teeth in occlusion or positional anomalies of teeth relative to one another in the same jaws. But in practice, malocclusion implies a condition in which the dental structures are not in acceptable equilibrium with each other or with the facial structures and/or the cranium thus interfering with or posing a potential threat to normal tissue development and maintenance, effective function, or a psychological behaviour problem.

Very often, malocclusion is regarded simply as an abnormal occlusion. The acceptance of such a definition has raised a wide speculation in what is really meant by normal. If normal means 'the common' or 'the usual', then we are confronted with the dilemma whether we should really accept the high prevalence rate (50% to 90% - see chapter on Prevalence and Incidence -) of malocclusions as 'normal' or 'deviation'.

However, it seems fair to say that the 'norm' (or normal) follows a certain standard, which calls for a specific requirement, and when compared with others, it always appears in the same manner. In clinical orthodontics, the developing dentition is never in a static form; it is always changing and progressing according to its genetic endowment endorsed by function in a specific environment at that time. Craber suggests that the cardinal axiom in defining 'normal' is that the normal in physiology is always a range, never a point. There is a marginal allowance for variations which are bound to occur very commonly in individuals. A balanced, stable, healthy and aesthetically attractive and functional occlusion is considered to be normal, even though minor rotations are present (23). The analysis and evaluation of a developing dentition should begin with a dynamic approach. The judgment should be based upon a comparison of the progress of the dentition not only with the arbitrary or the 'average' standards, but also with the specific rate of growth gradient, and its development and maturation with due regard to the age of the individual child. "The child", as suggested by Salzmann (55), "has many ages. These include chronologic, anatomic, physiologic, and maturative or developmental age. These ages do not progress all at the same rate, and may or may not coincide with chronologic age or with dental age in the same child. It is important, therefore, to correlate these ages with tables of normal standards in order to give

these factors due consideration in enabling a diagnosis. We should remember that the standards of growth and development do not apply with a high degree of exactness to the individual child. Variation is the basic law in biology."

Orthodontics

The study of orthodontics is closely associated with all the developmental and positional anomalies of the dentofacial system. According to the definition of the British Society for the Study of Orthodontics (68) : "Orthodontics is the department of Dental Science and Practice concerned with the treatment of malocclusion, i.e. abnormal position and/or relation of the teeth. It is based on (a) the study of the normal development and growth of the face and jaws as they affect the positions of the teeth; (b) the study of the etiology and prevention of malocclusion; and (c) clinical experience".

The highest aim of orthodontics is the prevention of malocclusions primarily, when possible, and their correction in the second place. An awakening of the biological implications involved in orthodontics has helped us to shift the importance from a pure mechanical approach back to a re-orientation of thoughts in basic bio-mechanic principles. Alton Moore (40) says: "Orthodontics is essentially a biologic science that is governed by all of the rules and regulations that apply to any other field of biology. Mechanical principles are incidentally used to bring about biologic changes in the periodontium and facial skeletal

patterns of patients". Following on the same line of thinking, Waugh (65) points out that there are at least seven recognized therapeutic factors, of which appliancing is the last one in his list. The factors are as follows:-

1. Physiologic therapy - instruction in proper use of the organs concerned with mastication, deglutition, speech and respiration.
2. Psychologic therapy - breaking of faulty habits and the establishment of habits favorable to optimum dentofacial development.
3. Exercises - employment of intermittent artificial aids to obtain optimum dentofacial development.
4. Myofunctional therapy - exercise and functional correction of dentofacial muscles.
5. Medical aid - reference for treatment to pediatrician, nutritionist, rhinologist, endocrinologist, allergist, etc.
6. Surgical therapy - removal of supernumerary and impacted teeth, repair of cleft palate, cleft lip and other gross dentofacial deformities.
7. Appliance therapy.

Interceptive and Preventive Orthodontics

Graber (23) and Mayne (38) both expressed the need to clear the confusion over the terms of "Interceptive Orthodontics" and "Preventive Orthodontics", which often appear concomitantly with ambiguity with respect to their relative areas in definitions.

Preventive orthodontics is one of the divisions of the art and science of orthodontics, and concerns itself in the preservation of the integrity of what appears to be the normal occlusion from untoward environmental forces, which may threaten to unsettle its balance and harmony during its course of development to maturity. This means that the dentition is normal to start with, and would be so maintained by proper function within a favorable environment. It is the responsibility of the dentist to appreciate this fact, and to endeavour to maintain the occlusal status quo. Several simple but important preventive measures can be carried out in a conscientious dentist's routine practice, such as : (1) recognition and correction of undesirable orofacial habits; (2) maintenance of proper arch relationships and dimensions by good restorative work, and by early correction of proximal caries, and the placing of space maintainers at the right time. Mayne called these procedures "the very backbone of preventive orthodontics." (38)

Interceptive Orthodontics, in contrast with the normal development of occlusion as in the case of preventive orthodontics, implies that an abnormal situation exists, whether still undiscovered, or in its incipient stage or well on its way to maturity. Interception means to take action with the purpose either to lessen its severity before the malocclusion becomes too pronounced, or to channel the course of development into other directions or in some cases to eliminate its cause, when possible.

Interceptive orthodontics also includes actions whereby "growth and/or eruptive forces may be constructively used to accomplish improved tooth and/or jaw relationship." (38)

The abnormality may be inherited disharmony with or without the aggravation of an associated unfavorable environment. If the environmental factor works in the same direction as hereditary inclination, the malocclusion will then become fully manifested in its later development. By removing the unfavorable environment, and substituting it with a favorable counterpart and assisted by proper function, many incipient malocclusions may become suppressed altogether or stunted in their development. A good example here would be a planned program of serial extraction in tooth-jaw discrepancy cases where the tooth material is in excess of the space available, and the timely removal of deciduous teeth and later the premolars can considerably reduce the overcrowding so that the integrity of the arch length is preserved.

In both preventive and interceptive orthodontics, the overall principle is to strive for the optimum condition for the individual in which the function, growth and development of his dentofacial units can be served with efficiency and harmony.

Corrective Orthodontics

Corrective orthodontics usually confines itself to mechanical procedures but of wider scopes in techniques than those used in interceptive orthodontics.

When a malocclusion has become established, either

after it has escaped through early detection and treatment, or the degree of hereditary factor for the responsible discrepancy is too intense for any procedures to intercept its early course, then corrective orthodontics is the final resort. Graber (23) suggests that corrective orthodontics be subdivided into :

(1) limited correction procedures that can be handled by the general practitioners, and (2) extensive corrective procedures which must require the skill and service of a qualified orthodontic specialist.

The General Practitioner

The general practitioner should handle all the preventive and interceptive orthodontic cases. He is in a unique position in which he is able to observe, supervise and guide the proper development of his young patient's dental health. But he must have the knowledge and ability to appraise the general development, and analyse the situation intelligently after a careful differential diagnosis before he can arrive at a conclusion, upon which he can suggest whether preventive, interceptive or corrective procedures be employed.

Also, the general practitioner has to know accurately the course and direction of a developing malocclusion; its probable effects and its end results; when treatment becomes imperative as well as when it is better to observe and wait for further developments. Periodic observation and timing of all services are pertinent to the ultimate success of a 'dental

guardianship' in which the general practitioner must assume as his privilege and responsibility. The importance of observation is shared by Cheney, who says (11) : "One of the most useful aspects of mixed (developing) dentition therapy is the practice of observation. By observation I mean the collecting of information and data about the growing teeth and jaws in order to determine their ability to adjust and adapt into satisfactory occlusion". Continuing examinations and case evaluations during the formative years are essential to successful preventive and interceptive orthodontic therapies.

There are many obvious reasons why the general practitioner must develop and orient his thoughts and routine dental procedures in orthodontics. Ponitz called this orientation 'orthodontic sense'. (49). "Which", he said, "implies management that is practical for the patient as well as for the dentist and that gives evidence of good, sound advice, with as little speculation as possible."

We can briefly suggest a few of the reasons as follows:

A) In the interest of the Patient.

- (i) Economically, most patients would benefit by early treatment of incipient conditions. They would, otherwise, spend more money, have a longer treatment time, and would require the service of a specialist.
- (ii) Functionally, aesthetically, psychologically, are enhanced by having suppressed, lessened or eliminated the unfavorable

factors which block the optimal development and growth of the dentition.

(iii) A dentist who is orthodontics-conscious in his approach would naturally give a much better treatment to his young patient than one who has not got this orthodontic sense. He would make certain that the patient's dental restorations are in harmony with the rest of the occlusal forces in various positions of mandibular movements; he would try his best to preserve the integrity of his patients arch judiciously within his capacity to control and would refer him to specialists when necessary. Any abnormal signs and symptoms beyond his qualification and experience to experts for consultation. All these procedures would help the patient to attain a better dental health status with less effort, time, inconvenience and money.

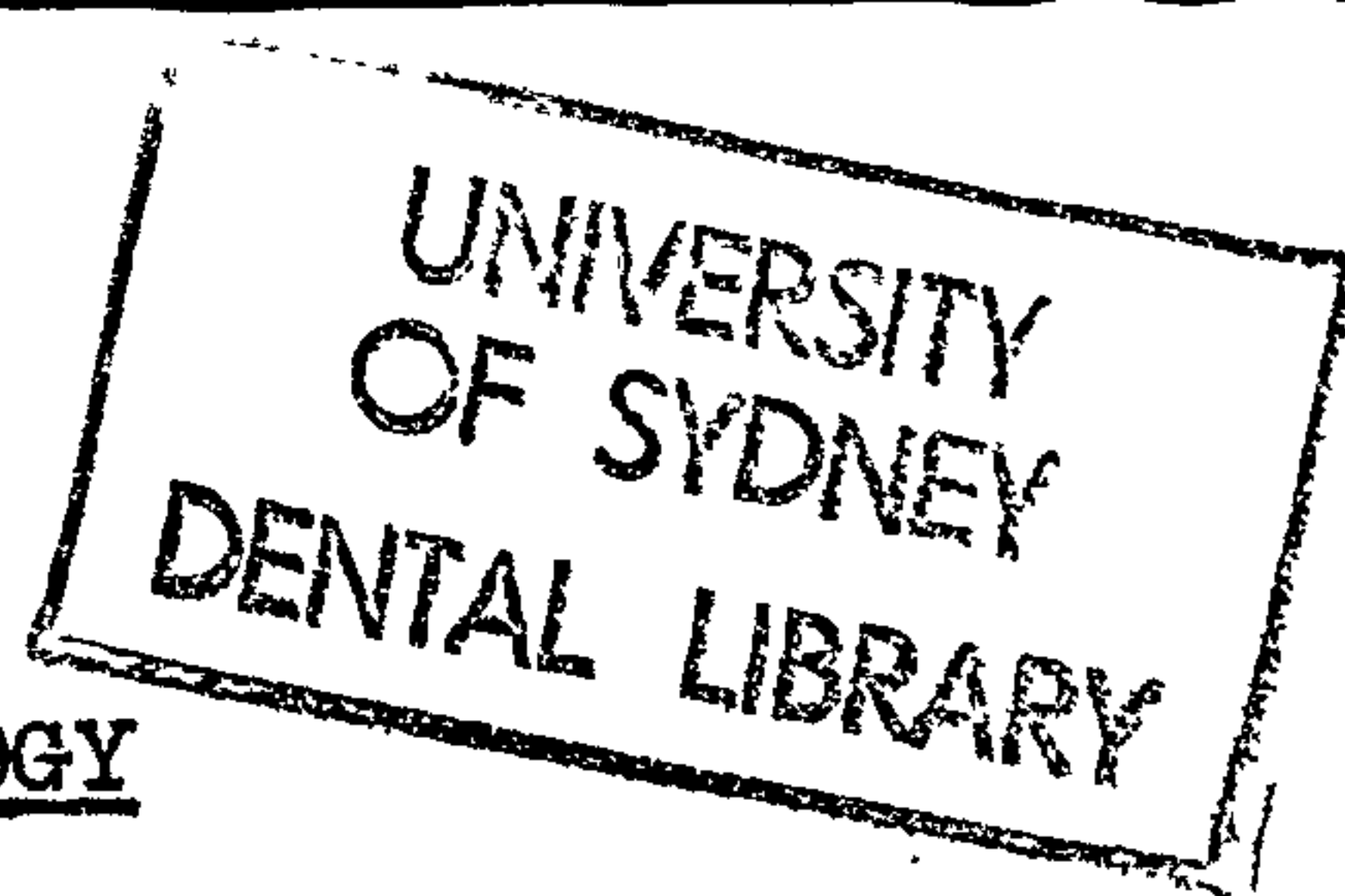
(iv) Speech difficulties may be improved by early orthodontic treatment after elimination of dentofacial defects.

Early orthodontic treatment may also:

- i. reduce susceptibility to dental caries.
- ii. increase longevity of dentition by reducing the risk of periodontal disease.
- iii. improve breathing.
- iv. eliminate undesirable oral habits.
- v. develop self-confidence and positive mental attitude.
- vi. develop an increased sense of responsibility towards dental health.

B) In the interest of the Dentist.

1. By adopting a positive attitude towards orthodontic problems in his practice, the dentist may find his professional horizon broadened; his work more interesting and rewarding; and has the sense of satisfaction of one who has done well as guardian of his patients' dental health.
2. His work and effort will not be spent in vain. The young patient and his parents can be positively influenced and won over by his sense of responsibility, and a healthy patient-dentist relationship is developed.
3. If all the orthodontic problems are referred to the orthodontist, not only the situation would become chaotic because of the shortage of orthodontists, but the dentist may miss out a most interesting part of his professional life of looking after his young patients' dental health.



CHAPTER 2. ETIOLOGY

The etiology of malocclusions is a complex one, for it differs from many other forms of infectious diseases or dental maladies in that it is neither a pathological nor a clinical entity. It manifests in various forms and patterns in which all seem to be morphologically alike, yet their etiologic backgrounds can be completely different. No one, as yet, can definitely sift out the etiologic role played by heredity in the causation of malocclusion, because heredity can be modified by function and environment. All we have been doing seems to limit ourselves to reason backward and attempt to establish the most likely causative factor among a host of others. True preventive and interceptive measures depend on an intelligent study and evaluation of the various etiologic factors. Orthodontists, suggested Graber (23), should be able to pin-point the causative factor, strip away associated conditions and verify it in broad populations.

Heredity, function and environment have been suggested (13, 23, 34, 38), as the most prevalent etiologic factors, which, very often, are intimately interwoven together and it is difficult to distinguish and isolate their relative roles in a fully manifested malocclusion. However, Cohen (13) says: "It is very probable that many malocclusions are additive, deriving from a genetic potential for a poor occlusion and made worse by the forces of function, nutrition, or habits of the developing

individual. Conversely, an unfavorable genetic pattern may be modified desirably by local factors during its development. When we consider that an occlusion is the endpoint of three tissues - bone, muscle, and tooth structure - each with its own, and not necessarily the same, genetic determinants and modifying environment, we can readily understand how the problem becomes compounded". Korkhaus (34) stressed the importance of the relationship between function and hereditary development of an occlusion. He considered that proper function is responsible for normal development of an occlusion, and also for introducing a favorable environmental condition for the dietitian to work with.

Grabner (23) also suggested that the interdependence of form and function and the inherent ability of the individual to adapt to a given situation would introduce a number of modifying factors that are responsible for the "status quo".

Hemley (28) focussed his attention on eight factors of occlusion which he considered to be responsible for the development and function of the dentition, and said that any disturbance of this delicately balanced system would result in a malocclusion and the manner in which these forces are disturbed would determine the pattern of the malocclusion. He listed the following eight factors as forces of occlusion :

(1) inherent force of growth; (2) metabolism; (3) action of muscles; (4) temporomandibular articulation; (5) inclined planes of teeth; (6) axial inclinations of teeth; (7) proximal contacts

of teeth, and (8) atmospheric pressure.

With a little generalization, many have attempted to categorize the etiologic factors into separate groups, each under a broad heading, such as indirect or predisposing and direct or determining (39); extrinsic or general and the intrinsic or local (23). However, Moyers (42) groups them into "7 causes and clinical entities":

- (1) heredity, (2) developmental causes of unknown origin,
- (3) trauma, (4) physical agents, (5) habits, (6) disease, and
- (7) malnutrition.

However, it must be born in mind that, irrespective of the origin of malocclusions, the final manifestation of all etiologic factors will find their presence as local causes, and the place where that cause shows its effect is most important. There are three important factors to be considered in addition to the identification of the etiology of a malocclusion. They are as follows:-

- (1) the time factor, e.g. the duration of the causes whether spasmodic, intermittent, or continuous, and the age at which they begin to operate whether prenatal or postnatal;
- (2) the nature of the causes, e.g. the magnitude and direction;
- (3) the primary sites involved; whether the jaw bones, or teeth and associated supporting structures or the neuromusculature of the facial regions.

Dockrell (14) represented this interrelationship by the following equation:

Causes	act at	Times	on	Tissues or sites	producing	Results:
Some predisposing Some exciting		Prenatal or Postnatal		Some primary Some secondary		May be the following or a combination of these
1. Heredity		1. Continuous or intermittent		1. Neuromuscular tissue		1. Malfunction
2. Developmental Causes of unknown origin		2. May act at different age level		2. Teeth		2. Malocclusion
3. Trauma				3. Bone and cartilage		3. Osseous dysplasia
4. Physical agents				4. Soft Tissues other than muscles		
5. Habits						
6. Disease						
7. Malnutrition						

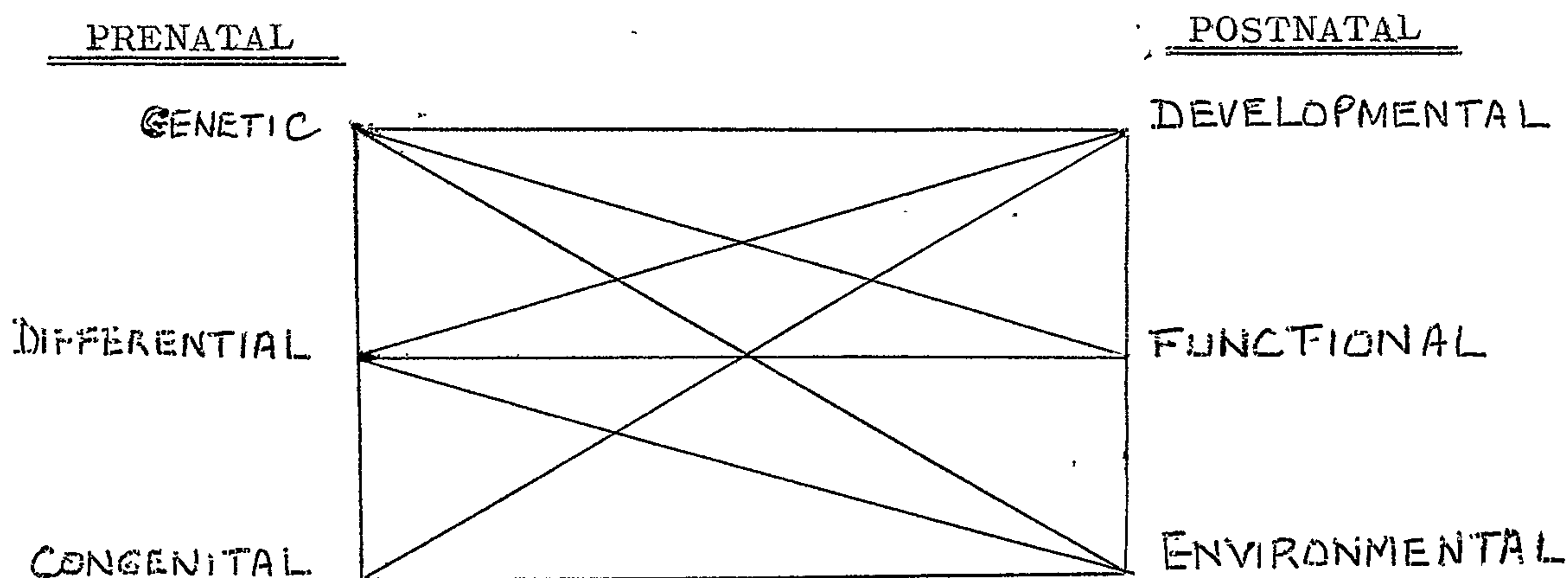
Dockrell's (14) elaborated orthodontic equation,
as quoted from Moyers (42)

Moyers (42) pointed out: "Rarely is one site alone involved: usually, other sites become affected. ... The result is malocclusion (teeth), malfunction (neuromusculature) or osseous dysplasia (bones), more probably a combination of all three". Later on he gave further elucidation as follows:-
"One rarely encounters a malocclusion that is solely a dental,

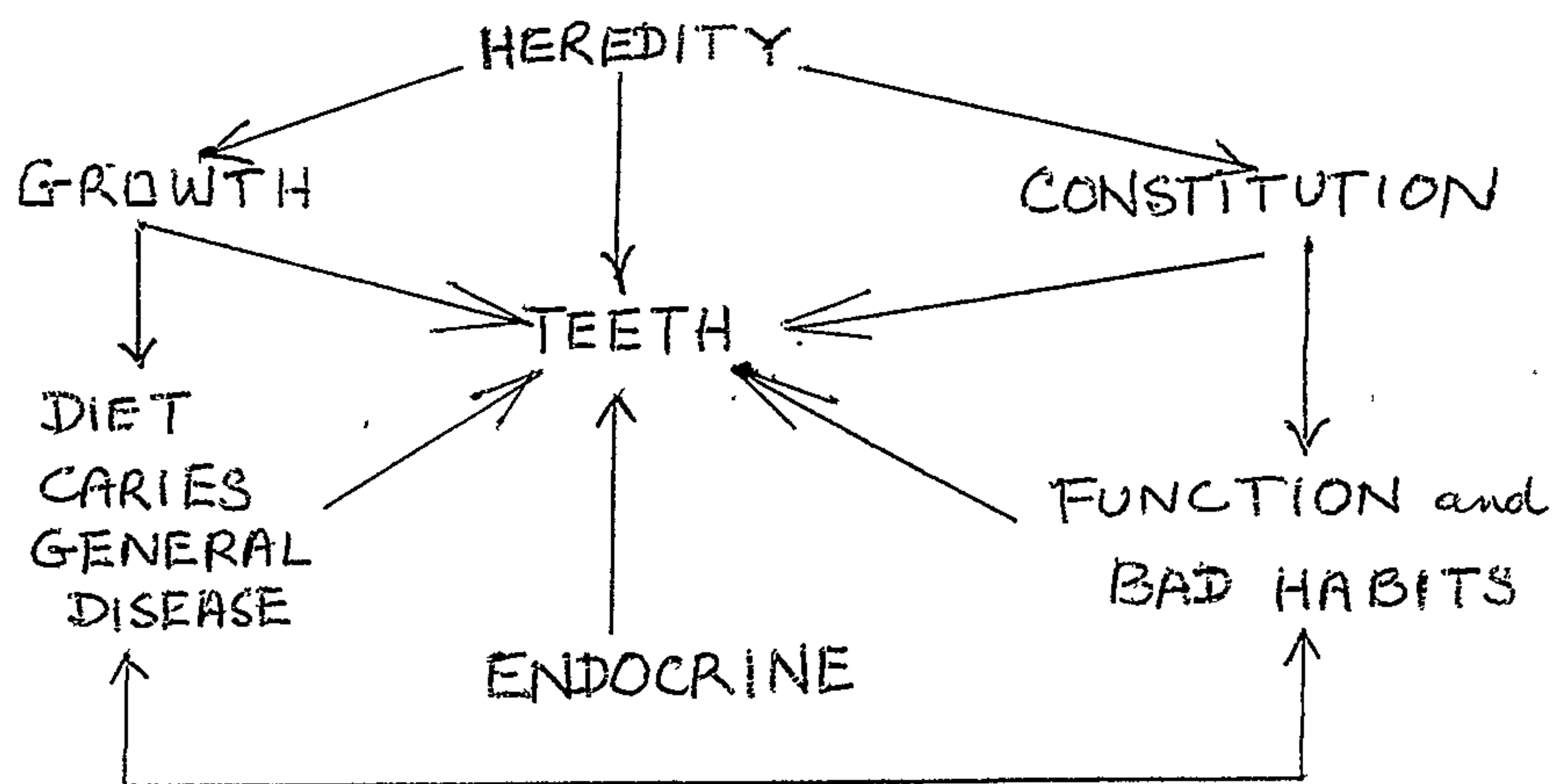
a muscular or an osseous problem. So intimate is the interacting relationship of growth that a change in one tissue easily affects another. For example, when the mandible is retruded, malpositions of the teeth must also occur. In time, the malfunctions of muscles probably will affect the size and shape of facial bones. Though all three tissues (bone, muscle and teeth) are involved in all dentofacial deformities, one is usually dominant: one is the primary etiologic tissue site. It is this one which largely determines the final treatment plan and prognosis."

Salzmann (56) and Hotz (30) schematized the close interdependence of etiologic factors of malocclusions by diagrams.

ETIOLOGIC FACTORS IN MALOCCLUSION



Salzman's Diagrammatic representation of interdependence of etiologic factors in malocclusions (56).



Hotz's Diagrammatic representation of interdependence of causative factors (30).

In Hotz's diagram, we can add the bones, neuromusculature onto "teeth" in the centre. The arrow shows the most important interactions between the individual factors.

An aspect of Hotz's diagram, as he pointed out, is that, although the factors on heredity, constitution, growth and endocrines cannot be influenced, but the group on the lower left corner, i.e., diet, general diseases, caries, and the lower right group of function and bad habits are to be influenced by early prophylaxis and treatment.

It is not the purpose of this review to enter into detail and elaborate discussions of how all these factors may affect the dentofacial structures, but it is felt that as both specialists and general practitioners should participate in the prevention and interception of malocclusions, it is, therefore, important that they should know the factors which are interceptible and/or correctable, and the factors which they cannot control. A brief review of these factors is deemed necessary.

1. Heredity.

A number of dentofacial morphologic characteristics have been suggested to have association with heredity (23, 47, 56, 42). Lundstrom (47) made some intensive studies on twins, and pointed out the following characteristics which can bear strong genetic influence:

- (1) Tooth size
- (2) Width and length of arch
- (3) Height of the palate
- (4) Crowding and spacing of teeth
- (5) Degree and sagital overbite (overjet)

In addition, it is generally assumed that heredity plays a part in the following conditions :

- 1. Congenital deformities, cleft palates and lips;
- 2. Tooth shape variations;
- 3. Mandibular underdevelopment and prognathism.
- 4. Bimaxillary protrusion and underdevelopment;
- 5. Discrepancy cases - where extremely large teeth combine with abnormally small jaws or vice versa.
- 6. Anomalies in number and abnormal positions of teeth, e.g. supernumeraries, anodontia and oligodontia.
- 7. Facial asymetries and soft tissue peculiarities.

Most of these conditions are not to be influenced by function or preventable, but a detailed knowledge of such conditions may enable the clinician to institute early interception and correction. If appropriate procedures are carried out at the right stage, they can effect favorable changes without the patient having to resort to prolonged treatment at a later date with the involvement of a great deal of expense, inconvenience and loss of time.

Schwarz (58) expressed that all typical malocclusions are as a result of a devious hereditary disposition and an

abnormal environment would promote and intensify the hereditary disposition. By constituting a favorable environment, the suppressed tendency of normal development may become dominant, but if the hereditary tendency runs in the same directions as the unfavorable environment, the typical full persistent malocclusion may result.

2. Trauma

Prenatal trauma during pregnancy, or postnatal trauma, such as birth injuries due to the use of undue force and the application of high forceps may damage the growth centres of the T.M.J., or deform the dental arches or jaw bones sufficiently as to affect their forms permanently.

3. Systemic diseases, chronic ill health, and endocrine disorders may affect adversely the developing stomatognathic systems. Anticipation of their influences would call for prompt action to be taken.

4. Malnutrition or faulty diet patterns may induce a poor prognosis.

5. Abnormal pressure habits, such as thumb and finger sucking, perverse swallowing habits, tongue thrust and tongue sucking, mouth breathing and obstruction of enlarged adenoids and tonsils should be corrected in the course of treatment. A high percentage

of malocclusion is caused by pernicious oral habits. The role of the family dentist is important in the detection and correction of their young patients' abnormal oral habits before they cause damage on the dentition.

6. An important group of local etiological factors in which the general practitioners can exert profound influence in the normal development of their young patients' dentitions consists of the following items: (i) improper dental restorations, (ii) dental caries, (iii) ankylosis of teeth, (iv) premature loss of deciduous and permanent teeth, (v) prolonged retention of deciduous teeth, (vi) delayed eruption and ectopic eruption of permanent teeth, and (vii) anomalies in number (i.e. supernumerary teeth or congenital absence), (viii) anomalies in shape and size.

CHAPTER 3. CLASSIFICATION OF MALOCCLUSION

The infinite variations of malocclusions which stem from a single to a combination of a host of various etiological factors preclude any scientific reasoning for logical classification as far as the etiology of malocclusion has not been established. For variation is the basic law of biological science and occlusion is so closely tied up with heredity, nutrition, metabolism, constitution of the organism and the environment in which the dentition is to function and to fulfil its maturity. No matter how desirable it is to have some sorts of classifications by which we can put the different morphologic forms of malocclusions into similar groups so as to facilitate ease of handling and reference, or for discussion and comparisons, or for further investigations, it is fair to assume that unless these classifications can carry with them the information of their etiological background, all classifications are limited in clinical practice. A morphologic classification is not a diagnosis, neither can it define the course of treatment nor can it predict the future prognosis of malocclusion. As Moyer (42) has aptly said, "It is this grouping and nothing more".

However, classifications are still very useful as long as their limitations are recognized. There is always a risk, however, that classification would soon become the ends in themselves and cloud out the main issue of intelligent differential

diagnosis and treatment planning.

Systems of Classification

The Angle system and the Simon system are the more popular types, especially the Angle system which is received more readily and with wider acceptance due to its practicability and simplicity. It is based on the hypothesis that the first maxillary molar is the "key to occlusion", (1) and that it always occupies an infallible position in the upper arch. This hypothesis has been found to be invalid, as shown by cephalometric studies that the maxillary first permanent molar may vary in its position anteroposteriorly and also in different stages of development of the dentition. Moyers (42) points out the risk that too much emphasis or attention on this one tooth relationship would cause the clinicians to lose sight of the dentofacial relation itself, and fail to develop a perspective view in the comprehension of the whole situation.

The Angle system of classification has been well presented in many standard orthodontic text books and will not be reiterated here.

The Simon system of classification has a 3-dimensional gnathostatic approach, in which the dentition is orientated to different anthropometric landmarks on the face. The dentition is related to the Frankfurt horizontal plane, the frontal view of the orbital plane, and the mid-sagittal plane.

The Simon system is probably more precise than the Angle system, but it is cumbersome, confusing at times (e.g. attraction is intrusion of the maxillary teeth and extrusion of mandibular teeth) and is less often used today.

The Simon system, however, has broadened orthodontic thinking by breaking down the emphasis on a mere tooth relationship and relating the dentition to the facial skeleton. Another advantage of the Simon system lies in its clarity in distinguishing the malpositions of teeth from those of osseous dysplasia by prefixing the primary site in which it is involved, e.g. maxillary dental protraction (teeth are anteriorly placed) and total maxillary protraction (the entire maxilla and its teeth are anteriorly placed with respect to the orbital plane).

CHAPTER 4. THE BASIS FOR AN OCCLUSAL INDEX

The task to establish an occlusal index is encountered with problems many of which the dental scientists have yet found no easy solutions. Some of these problems are parallel to those as discussed in the etiology and classifications of malocclusions. It has been demonstrated that there is an infinite number of variations of malocclusions, many of which are clinically alike, and yet their backgrounds may be completely different; that what is normal occlusion for one age may be abnormal at another age; and normalcy varies from one age to another; that occlusions are never static, and are modified throughout life by function, and many conditions are reversible through growth and development. Moyers (43) talks of the different etiologic factors as "the fantastic, innumerable etiologic routes for producing occlusions."

On top of the difficulty in giving a descriptive value to an occlusal index, we must also satisfy ourselves that the index will be able to express the different conditions in simple numerical terms for quantitative studies, and for comparisons between different groups of results for statistical purposes. Commenting on this, Moyers (43) points out: "We are trying to say in numbers how an important bodily function is affected by the development of dental tissues, the growth of bone, and the

response of neuromuscular mechanisms during natural and uneventful aging as well as when disease affects any of the three areas of tissue - bone, teeth or muscles."

In the epidemiological surveys of dental caries, the severity and magnitude of the condition is assessed by the presence or absence of disease, by the numbers of fillings and missing teeth--the D.M.F. index. That malocclusion has no such clear-cut approach is obvious. Moyers (43) again critically reviews the situation and comments: "Those who think that it will be a simple matter to propose an occlusal index, analogous to the D.M.F. or similar ratios of carious activity, are naive, blessed with amazing hope, or burdened very little with knowledge about the origin of occlusal dysfunction." It is indeed discouraging to hear him say: "There is no such formula and we have little hope that there will ever be one."

In a program planning for the prevention of malocclusion or the establishing of treatment centres in a community for children who have orthodontic problems, it is important to find out the following conditions:

- (1) the magnitude of the problem in terms of the prevalence and severity of malocclusions in the children of orthodontic age group, e.g. the needs, and
- (2) the eligibility of children with respect to the degree of severity or handicapping conditions of the malocclusions before they can become eligible for treatment.

The knowledge of such result findings are pertinent to the setting up of objectives and for obtaining base-line data, budgeting, staffing, as well as for intelligent evaluation or replanning of programs.

A good workable index for occlusion must be able to differentiate real dental relationships, skeletal disharmonies, and abnormal neuromuscular patterns, for each of the above conditions may have different treatment prognosis.

Such an index will be much broader than a conventional classification, e.g. the Angle classification, which was originally designed only for the clinicians. It does not indicate the severity or length of treatment time, and is not quantitative or objective enough to satisfy some of the basic requirements of an index for large-scale epidemiological studies of malocclusions. The epidemiologist or public health dentist is primarily concerned with the characteristics of the disease itself (i.e. its size, location, age and sex distribution); he is interested to compare the prevalence rate and incidence of the disease in different population samples. He deals with the problems of the community in similar ways as a clinician would do to his individual patients, but he is chiefly concerned with the prevention and control of the disease in the community, and not with the diagnosis and treatment of the disease of the individual. Understandably, many of the problems in which the clinician regards as need for treatment may not be problems at all from the public health

viewpoint; and conversely, a public health assessment of orthodontic need may not be satisfactory to the clinician. Following the same reasoning, the epidemiologist will need to have a more definite yardstick to go by for his assessment.

An index for occlusion should satisfy the following conditions (69):

1. It should be simple, accurate, reliable and reproducible.
2. It should be objective in nature and yield quantitative data which may be analysed by current statistical methods.
3. It must be so designed as to differentiate between handicapping and non-handicapping malocclusions.
4. The examination required must be one that can be performed quickly, even by examiners without special instruction in orthodontic diagnosis.
5. It should lend itself to modification for the collection of epidemiological data regarding malocclusion other than prevalence, incidence severity; e.g. frequency of malpositioning of individual teeth.

Draker included two more requirements as follows:-

6. It should be usable on either patients or study models.
7. It should measure the degree of handicap, if any, and avoid classifying "malocclusion".

Moyers (43) calls for the need to incorporate into the occlusal index the distinction between the primary and the

secondary sites involved. The index should bear some reference to the etiologic background of the malocclusion, as well as to indicate the severity and length of treatment. Moreover, it is desirable to have an index which can indicate whether the malocclusion should be handled by a qualified orthodontist or whether it can be taken care of by a general practitioner who has sufficient training in preventive and interceptive orthodontics.

This index is not yet available at the present moment.

CHAPTER 5. SYSTEMS OF OCCLUSAL INDICES

It is neither the need for treatment nor the deviations from the so-called normal occlusion that can be taken as the criteria for an occlusal index. The lack of objective criteria has hampered the progress of public health development in the direction of solving malocclusion problems. Subjective elements have made comparisons impossible between survey results of different groups either of the same country or with different overseas groups. It is a pity that large amounts of accumulated knowledge of good survey efforts have gone down the drain.

Many methods have been attempted. Most of the earlier ones were based on Angle classifications. Indeed, it is only during the recent decade that serious thoughts have been given to the establishment of objective criteria in an occlusal index. Broadly speaking, the criteria for measuring malocclusion in survey studies can be divided into the following groups :-

- (1) Angle classification, in toto.
- (2) Modification of Angle classification.
- (3) According to minimal need for treatment of handicapping conditions - a purely subjective view but an easily discernible fact.
- (4) Objective measurements with the help of simple instruments to measure the malpositions of teeth, e.g. overjet or overbite, crowding or spacing, etc.

- (5) Objective measurements of the dentofacial features by simple facial orthometer.

The methods will be discussed briefly according to their merits of accuracy, comparability, reproducibility, simplicity, and quantitative characteristics.

1. Surveys using the Angle system of classification

The inadequacy of this system has been previously discussed in detail without the need for its reiteration here.

2. Modification of Angle Classification

Massler and Frankel (37) conducted an epidemiological study of malocclusions of 2758 children with ages ranged from 14 to 18 years. Methods of assessment were based on the results obtained by taking the individual tooth as the unit of occlusion instead of a segment of the arch.

Method of inspection: Each tooth was examined twice, and from two different aspects, e.g. (i) occlusal contact line with its adjacent teeth with respect to the continuous arch shape, and (ii) interdigitation in the plane of occlusion with the opposite jaw.

Evaluation: Each maloccluded tooth was assessed a value of one without regard to the degree of its displacement, and it would be counted only once irrespective of its malposition in both examinations.

The total number of maloccluded teeth per person is

the basis for the evaluation of the prevalence and incidence of malocclusion in large population samples.

Advantages :

The method is simple, objective as far as the measurements are concerned. It requires no extra skill of the examiner and is sufficiently quantitative for epidemiological surveys.

Disadvantages :

It does not indicate the true jaw relationship antero-posteriorly or the amount of overbite and overjet, spacing or crowding. It does not indicate the need for treatment or length of treatment period. Except for the teeth concerned, it does not bear any reference to osseous discrepancy or any abnormal neuromuscular patterns. A severe Cl II division I with gross overbite and overjet but with intact arches and articulation may have a score of 0.

3. According to minimal needs :

(A) Moore (41) examined 7373 school children in 1948 using a subjective criterion which was based on clinical needs of the patient e.g. "Must something be done for this mouth to restore health or avert ill-health?"

Methods of investigation and assessment:

- (A) An opening statement which indicates whether the occlusion is functionally normal, (ii) borderline or (iii) abnormal.
- (B) Oral habits which should be removed.
- (C) Indications of conditions which (i) must be attended to now, or (ii) must be treated later.

As it is subjective in nature it does not allow for comparison, or any quantitative studies for statistical purposes. It would not allow for a later evaluation as there is no baseline measurement to start with. It requires the skill of experienced orthodontists to do the examinations and with the lack of objective criteria to draw the assessments, human errors in examinations would make the results non-reproducible.

But this method offers simplicity and speed as well as some indications for the need of the population samples. The method could be used as a preliminary screening procedure to assess the needs of the community preceding the adoption of a more satisfactory and refined method later.

(B) Fulton (20) reported the crippling conditions set down for the eligibility for public grants-in-aid programs designed to benefit the crippled child and minimum health standards of orthodontic service to be established for children by the U.S. Government.

4. Objective assessments with simple measuring devices :

(A) Van Kirk (64) used a small specially designed plastic tool to measure the notations or displacements of individual teeth in the anterior and right and left of posterior segments of the upper and lower arches. Each tooth present in a segment is scored 0, 1, or 2. A final malalignment index is obtained as the total of the six segment scores.

Method of Assessment:

Briefly, a score of 0 represents ideal alignment. Score 1 represents minor malalignment of two types e.g. rotation and displacement. Score 2 covers major alignments of more than 45 degrees rotation and displacement of more than 1.5 mm from its ideal alignment and with no contact areas with its adjacent teeth.

The method of assessment offers speed and simplicity in its application. The scoring is objective and gives an indication of the degree of malpositions by the weighted score. It does not require special skill in examinations and offers a high degree of reproducibility. It may be used as a preliminary epidemiological survey.

It lacks the specificity of the actual relationships of the jaws, as they are examined separately. The score may be zero in well developed dentitions, but the jaw relationship may be an advanced Cl III or Cl II Angle malocclusion.

(B) H L D Index

Draker (16) devised the Handicapping Labio-Lingual deviations (H L D Index) to measure the degree of physical handicapping condition of a malocclusion. The instrument used is a common Boley gauge.

Methods of assessments

Weighted scores are given to the following conditions observed :

Conditions observed

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- | | | |
|---|-----|--------------|
| 1. Cleft palate | | Score 15 |
| 2. Severe traumatic deviations | | Score 15 |
| 3. Overjet in mm | | |
| 4. Overbite in mm | | |
| 5. Mandibular protrusion in mm | x 5 | |
| 6. Open bite in mm | x 4 | |
| 7. Ectopic eruption, anteriorly only,
each tooth | x 3 | |
| 8. Anterior crowding:
Maxilla Mandible | | Score 5 each |
| 9. Labio-Lingual spread in mm | | |

Total

A score of 13 (tentative) and over constitutes a physical handicap.

Comments

The method is easy to carry out. It is simple (average time 3 minutes), and as far as the measurement is concerned, there is a relatively high degree of reproducibility, and the validity in accuracy with respect to subjective clinical judgment is good (80 per cent as claimed).

Again, it must be borne in mind that it was designed mainly for the purpose of screening handicapping conditions in which the public administrators would be more interested. There is no allowance for the following conditions:- jaw relationships, posterior crowding or spacing, cross bites etc.

(C) O.F.I. Occlusal Index

Another index, the Occlusion-Feature Index (O.F.I.) originally developed by the U.S. National Institute of Dental Research (N.I.D.R.) in 1957, was reported by Poulton and Aaronson (51). The O.F.I. was based on the assessment of four primary features of an occlusion which are of importance in an orthodontic examination.

Method of examination and assessment

1. Lower anterior crowding in the anterior segment:

Score 0. none

1. crowding of lower anterior teeth equivalent to one-half the width of the lower right central incisor.
2. Crowding equal to the width of one central incisor.
3. Crowding exceeding the width of one central incisor.

2. Cuspal interdigitation observed in occlusion looking at the right pre-molar-to-molar area from the buccal aspect.

0. Cusp to groove relationship.
 1. Between Cusp and groove.
 2. Cusp to cusp.

3. Vertical overbite, measured by that portion of the lower incisors in occlusion.

0. Incisal third of lower incisors.
 1. Middle third of lower incisors.
 2. Gingival third of lower incisors.

4. Horizontal overjet, measured in occlusion with a small ruler from labial surface of upper incisors to labial surface of lower incisors.

0. 0 to 1.5 mm

1. 1.5 to 3 mm.

2. 3 mm and over.

Possible range of score : 0 to 9.

Comments :

The O.F.I. is simple, rapid, reproducible and objective, and is also quantitative enough for comparisons to be made between different groups of population samples. But several features essential to an occlusal index are omitted, which considerably reduce the validity and practical application of the O.F.I. There is no provision with respect to the need of treatment or severity of malocclusion, or posterior spacing or crowding, and more importantly, it does not allow for upper anterior crowding or ectopic eruption, which often prompt patients to seek orthodontic treatment or they can block a healthy psychological development of the child. Neither does it allow for mandibular prognathism, which could have a more pronounced effect on the child than a mandibular retrusion would have.

(D) Modified O.F.I. occlusal index.

Based on the same reasoning of the O.F.I., Godfrey (22) developed and expanded it further to include several more features, such as :-

1. Lower posterior crowding, molar to canine; right and left side scored separately.
2. 'Vertical overbite' is divided into open bite and closed bite.
3. Horizontal overjet is extended to cover mandibular protrusion as well as maxillary protrusion.
4. Cuspal interdigitation on the right and left side is scored separately. (O.F.I. scores the right side only).
5. Buccal-lingual relationship (cross-bite) of molars and/or premolars right and left sides are scored separately.
6. Recording of functional mandibular shift. This is a new feature and is not found in any previous occlusal index.

Comments :

This modified O.F.I. yields more information about the occlusal features and would appear to be a more selective index than the original O.F.I. developed by the N.I.D.R. It is a longer procedure, and is more involved, and this might introduce errors during the recording and examinations. The reproducibility and reliability of the modified index, according to Godfrey's opinion, are points still to be analysed. As regarding its sensitivity, the author says, "It does seem that it does not produce anything substantiably different from the basic N.I.D.R. method (e.g. the O.F.I.)."

5. The Dentofacial Index (D.F.I.) was reported by Elsasser (19). Without going into detail, the D.F.I. works by measuring the dentofacial morphology on specific anthropological landmarks in the face by a specially designed instrument called facial orthometer, and compares the result findings with the mean values of

some predetermined measurements obtained from children who appeared to have ideal occlusions. The scoring system is as follows:-

- Score : 0 : for measurement within one standard deviation of the predetermined results.
- 1 : for measurements within two standard deviations.
- 2 : for measurements within three standard deviations.
- 3 : for measurements outside the limits of three standard deviations.

A weight of 3 is scored separately in the presence of cross-bite or crowded dental arches.

Range of scores : 0 in an ideal dentofacial pattern to 21 in the most extreme dentofacial malrelation.

Comments

The validity of the D.F.I. has yet to be proved with respect to its accuracy between the dentofacial features and the conditions existing in the mouth. However, the procedures are simple, rapid, and the result findings are objective. But the index does not truly indicate a refined enough sensitivity to supply information on the severity of malocclusions or the need for treatment.

CHAPTER 6. PREVALENCE OF MALOCCLUSION

In the study of the prevalence and incidence of malocclusion, scores of large surveys have been undertaken in many countries. Most of the findings were tabulated either according to the system of the Angle classification or its modifications. The inadequacy of the Angle classification as a true index for malocclusion or as an indication for treatment has been discussed in previous chapters on Classifications and Index Systems of malocclusions (i.e. Chapters 3, 4, 5.). Suffice to say that these result findings do no more than record deviations from the recognized standard anteroposterior molar relationship of the Angle classification.

The differences observed in the survey findings may be due to a number of reasons, such as: different countries with varying standards of dental health; different socio-economic patterns and development; age group differences; different criteria used during recording; difference in the background and training of examiners who carried out the examinations; different sample sizes and sample selections; racial and geographical characteristics of the population samples; the amount of fluoridation in the drinking water; the diet patterns etc. All these would actually account for the discrepancies in the observed results. It is, however, intended to point out that some of the differences are apparent ones, while others are due

to real differences.

The prevalence of malocclusion appears to be greater during the mixed dentition period, probably because of the many changes which are taking place during this transitional period. (See Table I). Another significant factor in the contribution of a higher prevalence rate of malocclusion is due to the premature losses of deciduous teeth and first permanent molars (See Table II), or the breaking down of arch integrity due to rampant caries. Fluoridation of water not only helps to reduce the amount of caries in the mouth, hence the reduction in the loss of teeth, but also if caries is found, it does not progress as rapidly when compared with the caries process as found in teeth in fluoride-deficient areas (5).

Table I. Studies of the prevalence of malocclusions and antero-jaw relationship according to major occlusions in the mixed and permanent dentition.

Examiner	Country	No.	Age	Cl 1 %	Cl 11 %	Cl 111 %	Total Mal. %
McCall [*] 1944	U. S. A.	623	7-11	47.0	11.0	2.0	60
Brandhorst [*] 1945	U. S. A.	50095	6-13	32.0	8.0	1.6	41.6
Newman [*] 1956	U. S. A.	3355	6-14	38.2	13.2	0.5	51.9
Krogman [*] 1952	U. S. A.	586	6½-13	28.0	24.4	1.7	54.1
Massler & Frankell [*] 1951	U. S. A.	2758	14-18	50.0	19.38	9.43	80.0
Savara [*] 1955	U. S. A.	2774	14-18	50.1	19.4	9.4	78.9
Gardiner [*] 1956	England	1000	5-15	65.7	8.1	0.4	74.2
Goose [*] 1957	England	2956	7-15	24.8	16.1	2.9	43.8
Popovich [*] 1955	Canada Canada	92 87	10 12	22.7 35.6	30.4 33.3	1.1 2.2	54.2 71.1
Taylor(62) 1935	Australia	619	0-15	58.3	10.1	5.0	73.4
Barnard (6) 1956	Australia	6787	6-15	78.4	1.6	1.1	81.1
Godfrey(22) 1963	Australia	1045	4-17	73.71	16.0	2.1	92.0
Hertel ^{**} 1955	Italy	3203	5-14	51.6	15.6	4.3	71.4
Telle ^{**} 1951	Norway	2349	7- 8	30.1	21.4	7.3	58.8
Mansbach [*] 1936	Switzer- land	2500	-	80.0	17.2	1.8	99.0
Korkhaus [*] 1928	Germany	568	14	41.7	13.2	0.5	55.4

* Source of information from Haryett, R. D. (27)
 ** Source of information from Dockrell, R. B. (15)

Table II. Prevalence of Malocclusion attributed to premature extraction of deciduous molars

Author and Year	Description of sample	Number	Age	Per cent with malocclusion	Country
Lyons 1924	unselected group	5,000	5-12	65% of all with tooth loss with a malocclusion	U. S. A.
Korkhaus 1928	"	643	6	1.4	Germany
Korkhaus	"	568	14	27.3	Germany
McCall 1944	"	152	2-6	3.9	U. S. A.
McCall 1944	"	623	7-11	12.0	U. S. A.
Gardiner 1956	"	1,000	5-15	19.0	England
Rhobotham	"	100	-	37.0	U. S. A.
Schachter 1933	all cases of permanent loss	130	11-16	26.2	England
Schachter	all cases with extensive losses (48 deciduous molars)	50	2-5	68.0	England
Seipel	all cases of premature loss (examined about 10 years after extraction)	50	-	20.0	Sweden

Source: Haryett (27).

Malocclusion and Fluoridation

The correlation between the prevalence of malocclusion and fluoridation of water was reported by Hill et al. (29) in 1959. Children of 6 to 8 years old in one group and 12 to 14 years old in another group in Evanston, Illinois, where water fluoridation had been practiced for ten years, were compared with (i) children of similar age-groups in Evanston in the pre-fluoride period and (ii) a control group in a fluoride-free area. They found 20 per cent less malocclusion among the 6-8 year old children and a 17 per cent less among the 12 to 14 year old children compared with the pre-fluoride data. In contrast to the reduction of the prevalence rate of malocclusions among the children in Evanston, they observed an increase in the prevalence of malocclusion in the control area over a nine-year period between examinations.

Prevalence

In another recent study of the prevalence of malocclusions as related to dental caries and loss of first permanent molars in a fluoridated city and a fluoride-deficient city, Ast, Allaway and Draker (5) confirmed the findings of Hill et al that there was a general reduction in the prevalence rate of malocclusions in children who lived in fluoridated city than those who lived in fluoride-deficient cities.

Early Loss of Teeth and Malocclusion

Benson (8) reported that 82 children living in an

institution were brought up in a non-cariogenic diet, and were found to be relatively free of caries on examinations. These children had no history of early loss of deciduous teeth or first permanent molars. Benson reported that there was 40% of normal occlusion among these children, with 34% of Cl I and 26% of Cl II malocclusions.

In a control group of 66 children of similar ages with a history of early loss of permanent teeth, Benson found that this group of children had only 10% of normal occlusion, with 60% of Cl I, 27% Cl II and 1.5% Cl III Angle malocclusions.

The significant findings revealed the ill-effect of early loss of deciduous teeth and of first permanent molars on the dentitions which resulted in a reduction in the number of normal occlusions and a steep rise in the number of Cl I malocclusions.

Finger sucking and malocclusion

Rosenzweig (70) reported of an increase in the incidence rate of malocclusion in Jewish children living in collective settlements (Kibbutzim) in Israel, especially of the type of malocclusion related to prolonged finger sucking. He explained that these children were separated from their parents for the greater part of the day, and despite their excellent environmental conditions, they felt strained and deprived of parental love, and tended to compensate by finger sucking as an act of self-gratification.

Susceptibility of Individual Teeth to Malocclusion

Massler and Frankel (37) did a survey on 2758 children in Chicago and actually counted the number of malpositioned teeth in the mouths of the children aged from 14 to 18 years. In this way they were able to eliminate the counting of deciduous teeth. They found that the most frequently maloccluded teeth were arranged in the following descending order :

1. Lower central incisors
2. Lower lateral incisors
3. Lower cuspids
4. Lower second premolars
5. Lower first premolars
6. Lower second molars
7. Upper lateral incisors
8. Upper central incisors
9. Upper second premolars
10. Lower first molar
11. Upper cuspid
12. Upper second premolars
13. Upper second molars
14. Upper first molars

They also found that the anterior segments had slight but consistently greater number of maloccluded teeth than in the posterior segments, and that the four first molars accounted for 60% of all missing teeth.

Cleft lips and palates

The handicapping conditions of children with congenital clefts of the lip and palate should deserve the special consideration of both the Public Health administrators and the Department of Child Welfare, because these malformations would severely block the mental and physical growth and development

of the children affected. The responsibility to care for these unfortunate children should rest on the Government, and on all related health workers as well as on the community, so that they may live a happy, normal life. The care of such children requires a close team work of the pediatrician, the surgeon, orthodontist, dentist, psychologist, speech therapist, social worker.

Greene (71) reported on the incidence rate of cleft lips and palates and stated that cleft cases appear to occur more frequently in the recent decades than before (see Table III). The difference may be due to two factors: (1) an apparent increase and (2) an actual increase. The apparent increase was due to an increase of sources of information, completeness of case findings, criteria for selecting cases, sample size, and a lower rate of perinatal mortality. Part of the actual increase may be due to a hereditary influence transmitted to the offsprings of parents who had clefts of lips and/or palates. Better plastic surgery and greater habilitation programs have enabled more people with clefts to marry and have children (71). More complete and accurate records for statistical purposes can be obtained if all births with clefts are made compulsory to report to the authority.

Table III Estimates of the frequency of cleft lip and cleft palate

Year	Location	Source	Number of cases	Sample size	Cases per 1,000 persons	Study population per case
1864	St. Petersburg, Russia	Foundling hospital	118	180,000	0.66	1:1,525
1908	London, England	Hospital admissions	39	67,945	.57	1:1,742
1918-19	United States	Army draftees	1,466	2,510,791	¹ .53	¹ 1:1,880
1926	Baltimore, Md.	Birth records:	24	28,085	.85	1:1,170
		White	17	15,565	1.09	1:915
		Negro	7	12,550	.56	1:1,793
1931	Lubeck, Germany	Population survey	28	34,000	.82	1:1,214
		Birth records	102	102,823	.99	1:1,008
1934	Holland	"Babies"	16	15,270	1.05	1:954
1934	Hamburg, Germany	Birth records	74	47,200	1.57	1:638
1928-37	Gothenberg, Sweden	Birth records	28	27,000	1.04	1:964
1910-40	Denmark	Birth records:				
		All births	193	128,306	1.50	1:665
		Live births	175	121,102	1.45	1:692
1938-39	Hawaii	Birth records	35	18,024	² 1.98	² 1:550
1942	Pennsylvania	Birth records	250	202,501	1.23	1:810
1935-44	Wisconsin	Birth records	736	567,509	1.30	1:770
1942-47	Hawaii (7)	Birth records	93	47,153	1.97	1:507
1943-49	Ontario, Canada	Surgical records	695	655,322	1.06	1:943
1948-50	Pennsylvania	Birth records	766	583,690	1.31	1:762
1948-55	New York ³ (8)	Birth and death records	1,414	1,242,744	1.14	1:878
1940-50	Birmingham, England (9)	Multiple sources	285	218,693	1.30	1:767
1951-55	Pennsylvania (10)	Birth records	1,269	1,201,976	1.06	1:947
		All possible sources	1,592	1,201,976	1.32	1:754
1955	California (11)	Birth records	368	313,164	1.18	1:851
1953-57	Denmark (12)	Surgical records	644	393,457	1.64	1:754

¹ According to data given, should be 0.58 cases per 1,000 and 1:1,713.

² According to data given, should be 1.94 cases per 1,000 and 1:515.

³ Exclusive of New York City.

SOURCES: Reference 6, except where another reference is cited after location of study.

CHAPTER 7. EUROPEAN AND AMERICAN ORTHODONTICS

Any comparison made between the European and American orthodontists has to be found on a general basis. Their aims are similar, with the same ultimate objective to offer their patients - optimal dental health. Both are interested in research and aspects of dentistry relating to the prevention and interception of malocclusions. Yet their differences are great and profound, and these can be found primarily in their treatment approaches and methods, appliances used, and their extent and perfection of treatment aims, training of personnel and organization of orthodontics on the whole, and secondarily in the forms of services they practise orthodontics and the recognition of financial remuneration for service rendered.

Undoubtedly, many of these differences have deep-seated origins such as are found in the cultural, educational and socio-economic patterns of the country; the availability of orthodontic personnel and resources, political background, etc.

The European Scene

Most European countries regard orthodontics as a part of children's dentistry primarily, and not as a specialty and that orthodontics is something that "the general dentist must know, and the childrens' dentist must be fully conversant. Childrens' dentistry without orthodontics is unthinkable." (30) Hence the treatment approach in the European schools has to be

concise, comprehensive, if it is intended for the non-specialists to understand and apply it clinically in routine general practice. Simplicity in treatment methods plus the emphasis on early introduction of orthodontics in the undergraduate curriculum - a subject which is highly regarded by both students and teachers and ranks on a par with other clinical subjects, has bolstered the interest and readiness of practitioners conscientiously to practice interception, prevention and limited correction of malocclusions. Severe malocclusions are to be treated by specialists, of course. Their system works well under their own socio-economic pattern, and there appears to be little misunderstandings between the specialists and the general practitioners regarding the treatment of malocclusions.

This simplification of orthodontic therapy is made possible because the Europeans have made great advances in the development of removable appliances, such as the activators or monobloc, generally known as the F.K.O. (functional jaw orthopaedics) appliances, advocated by Andreson, Haupl, Schwarz, Hotz, Korkhaus since as early as 1930. The success of their orthodontic treatment depends a lot on early detection and recognition of incipient malocclusions. They usually start the treatment on children at the age of eight to ten years (30). At this stage the inherent growth factor can be utilized to the most to attain the desired final results. In fact, their emphasis is centred on interception and prevention at an early age rather than on

full treatment of manifested malocclusion in the permanent dentition. Early treatment in the deciduous dentition is exceptional and is limited to very severe cases (30). Extraction cases are usually regarded as inadvisable except in discrepancy cases where the teeth are definitely too large for the jaw (35).

The European schools are all in favour of early therapy in which they make use of the natural growth, and direct it and to stimulate it in the sense of development towards a normal dentition (54). They are convinced of their ability to stimulate growth centres in the T M J articulation more than would normally take place. They practise the forcible expansion of the mid-palatal suture in suitable cases in order to correct crowding and arch relationship, and to widen the narrow nose passages for free nasal respiration. In the treatment of Cl II Angle malocclusion, they claimed that the correction is done through new apposition of bone in the T.M.J. and the mandible is advanced 'in toto' (35, 54), whereas the teeth are only moved slightly.

As orthodontics is practised by most general dental practitioners, they aim at the 'individual optimum' as the standard of treatment for their patients so that they can obtain a satisfactory balance of dentition functionally and aesthetically rather than to aim for the perfect occlusion of a 'standardized denture' for every person. Hotz (30) was greatly in favour of making orthodontics reach the public and therefore suggested

that the aim should not be set too high. He said, "Overshooting this aim would be difficult, time-consuming, often harmful, and lacking good permanent results".

It is understandable that individual tooth movement is not aimed for in the European method and anyhow, it cannot be obtained with their activators type of appliances, which can produce gross movements quite satisfactorily, but become ineffective in the correction of rotations of individual teeth, or its bodily movement.

The American Scene

Orthodontic practice in the U.S. presents quite a different view from that of the European. One cannot help but be impressed by their vast and well-developed organization and advancement in the art and science of orthodontics. The study of orthodontics in the U.S. has been following the thoughts and technics developed and advocated by strong orthodontic personalities such as E.A. Angle, Martin Dewey, Calvin Case, R.H. Strang, of the older generation, and of the recent groups such as Allan Brodie, Alton Moore, T.M. Graber, Robert Moyers, and other dominant figures who stand out as leaders in the field of orthodontics. All these men have had influence throughout the North American continent, and indeed, indirectly throughout the world.

With the unselfish devotion of these men, the orthodontic profession has reached a very high standard, and indeed, the first specialty board in dentistry was the American Board of

Orthodontics, which was only preceded by the American Board of Ophthalmology in the field of medicine in 1917. Orthodontic education, unlike any other dental subjects, began as a graduate course in the United States. It was first started by E.A. Angle in 1900, in his independent school. The course was extended to several week's length, and even at that time, Angle laid strong emphasis on anatomy, biology, histology and other related subjects. His motivation, strength of purpose, and devotion to work, and enthusiasm for teaching were infectious and attracted outstanding teachers in basic science. Many of his students became outstanding personalities and made significant contributions in orthodontics (12).

For the first quarter of the century, Angle's influence and teaching dominated and prevailed, but later, as scholars in orthodontics matured, they developed independent concepts and appliances, and some of them set up schools of their own. Today, Americans are still very much adhering to the definite systems of treatment as evolved by these men. Recently, the Begg technique of light differential force has gained a welcoming popularity in the American scene, and quite a number of schools has given it a priority in teaching and in practice. But the Tweed edge-wise system (introduced first by Angle in 1920), Johnson's twin wire arch appliance, Oliver's labio-lingual appliance, Spencer Atkinson's Universal Appliance and Crozart's removable all-metal appliance also enjoy popularity in different parts of

the U.S. continent.

Orthodontic practice enjoys a high esteem among the U.S. dental profession, and is regarded as a specialist's job. It is much more selective and exclusive than the European's practice, and it is, therefore, necessarily limited in the number of treated patients. Compared with the current European orthodontic practice, the American orthodontists are more exact and detailed, and aim at a standard in which they place great pride, and not without justification. Halliday (31) related his impression of the American orthodontist's working conditions, saying "Compared to our own standards, (Australian), he has on the average twice the space and facilities to work in, has twice the amount of chair side-assistance, sees half the number of patients and receives three times the remuneration in fees. He perhaps works longer hours and treats each case with meticulous care. There are no short cuts or compromise in treatment. His appliances are elaborate and he aims for perfection. He is keen and interested. He is found not only in the capital cities but also in the country towns, suburbs and villages."

Unlike the European counterpart, with their emphasis on group movement of teeth, their treatment approach is based on individual tooth positioning, and they aim at the optimum inter-digitation in occlusions (61).

Also in contrast to the European's approach to the treatment of malocclusions by encouraging more general practit-

ioners and pedodontists to participate in the actual orthodontic treatment practice, the American orthodontists are very concerned about this and have constantly expressed their anxiety that the U.S. general practitioners and pedodontists should take up any corrective procedures at all, except in simple cases, or simple immediate problems of complex cases, but they all agree, however, the important role that can be played by general practitioners in the matters of prevention and interception of malocclusions (24).

The qualification to join the membership of the American Association of Orthodontics is that he must have completed a graduate or postgraduate course in orthodontics, or completed all the requirements laid down by the Qualifying Board of the American Board of Orthodontics in the preceptorship program, and must be in full-time practice. It is clear that orthodontics, as a specialty, has undoubtedly prevailed throughout the whole thinking of the U.S. orthodontists. "The primary purpose of specialty practice is to protect the dental health of the public by identifying practitioners with special competence and training that enables them to care for professional problems of an unusual or difficult nature." (60).

There is yet another distinction between the American and European schools regarding the basic concept of treatment as far as the European functional jaw orthopaedic versus the American view on orthodontics is concerned. This distinction will be discussed later in the following chapter.

CHAPTER 8. ORTHODONTIC APPLIANCES

Removable appliances

Even a very brief description of the types of appliances used is out of the scope of this review. Suffice to say that there are two main types, i.e. (1) Active type, by which actual tooth movement, or expansion of the mid-palatal sutures, can be secured by means of springs, screws, or attachments built within that appliance. (2) Passive type; these appliances have no springs or attachments and are generally referred to as Andresen appliances or activators (i.e. F.K.O. or functional jaw orthopaedics). They bring about tooth movements by stimulating reflex muscle activity which in turn will bring about the change.

The Adams arrowhead clasp (82) is perhaps one of the most versatile and commonly used active type of removable appliances. It provides satisfactory and rigid retention from which individual tooth movements can be effected through the use of finger springs without fear of the plate being displaced. To obtain the best results, the suggestions on the design and construction of the clasps by Adams must be followed diligently.

Removable appliances are predominant in the European orthodontic societies, and the F.K.O. (functional jaw orthopaedics) type enjoys high popularity in the Continent. Andresen and Haupl (Norway) advocated its use in early 1930, and it has been improved and modified by many others, of whom Korkhaus (Germany),

Schwarz^{*}(Austria), Hotz (Switzerland) are some of the prominent figures.

The simplest types of activators are the oral screen and the monoblocs. Andresen (4) believed that the orofacial musculature can play a major part in the positioning of the teeth, and reasoned that by creating new reflexes in the perioral neuro-musculature 'autogenic forces' thus released can be used to influence the positions of the teeth and their adjacent bony structures. The monobloc, fully described in many European orthodontic text books and in the literature, is a loose fitting appliance which consists of a system of cleverly arranged inclined planes acting exclusively by transmitting functional forces created by the orofacial musculature.

The mono-bloc, one of the most commonly used activators, is simple and versatile and is efficient especially in the early correction of disocclusion, (Cl II malocclusions), of open bites, and in cases of deep overbite requiring a space maintainer in the mandible (30).

It has been suggested that the F.K.O. appliance corrects disocclusion in the following three ways (34, 35, 54) :

- (1) by an alveolar distal movement of the upper buccal teeth,
- (2) by an alveolar movement of the lower teeth, and (3) by a forward movement of the entire mandible, although it was admitted that the alveolar movements of the teeth are limited in this nature and take a long time. However, the European schools are

* A.M. Schwarz passed away in the middle of 1963.

keen to demonstrate that, with the activator, the correction of distocclusion can take place exclusively through the mesial development of the entire lower jaw in toto merely through its favorable effect upon the epiphyseal cartilage of the temporomandibular joint. Korkhaus (34) stated: "The forward movement in toto of the lower jaw, as well as the simultaneous movements of the upper and lower teeth under the mesial thrust can be very clearly recognized". Commenting on the transformation on the growth centres of the temporomandibular joint articulation, Graber (54) was very sceptical, and remarked: "There is a strong body of opinion which denies that there is any possibility for any permanent transformation of the temporomandibular joint by any form of orthodontic therapy I am not convinced that the evidence is yet strong enough to demonstrate a change of direction or increase in growth that has occurred which would not have occurred quite naturally in any case ... We (American) do not feel that forward positioning of the mandible effects any change in the temporomandibular joint. We recognize your success but we are still not fully agreed on the essential reaction which has brought about these changes."

Some activators include labial loops, and expansion screws to effect control of gross tooth movement and expansion of the upper arches by forcibly widening the mid palatal sutures with the screws.

A functional jaw orthopaedic appliance which is commonly

used in Europe and in other countries is the oral screen. It is one of the simplest forms of orthodontic devices for bite correction and activation, for correction of pernicious oral habits as well as for perverse sucking and swallowing and as a device for orofacial musculature exercises, and very often it is used in the correction of maxillary anterior protrusion where the dist-occlusion is not too severe. However its use is limited to mild cases of malocclusion.

Fixed appliances

Detailed descriptions of the different types of fixed appliances can be found in text books and literature.

(1) Edgewise appliances:

Angle first introduced the edgewise (2). It is a multi-banded precision appliance consisting of a rectangular labial archwire ligated into horizontal slots into brackets on all teeth to the second molars. Control in all directions is possible, and any individual tooth may be moved simultaneously in all three directions, with one adjustment of wire, labially or lingually, distally or mesially and rotated along its long axis.

The edgewise is not suitable for mixed or primary dentition, but more versatile in the treatment of comprehensive malocclusions of the permanent dentition.

(2) Johnson's twin-wire appliance:

Johnson (32) introduced and designed it in 1930. His original thought was that if two light wires were placed in the

same bracket, there would be a more physiologic movement created than could be obtained with one heavy wire. It is said that it would permit rapid reduction of rotation and a more precise control with minimal adjustments. It finds its greatest use in the mixed and early permanent dentition.

(3) Begg's light wire technique (72) has appealed to a number of orthodontists because of its efficiency in bringing about a shorter treatment time and longer intervals of adjustment.

The treatment philosophy is based on the ability of the appliance to differentiate the amount and direction of the applied force in separate areas by the use of round high tensile spring wire. Vertical and horizontal loops, diagonal torquing spurs, tip back bands are bent into the arch wire, which exerts a lighter, more gentle and continuous force, and yet effects torque and rotational changes. The ability to set up differential force in a reciprocal manner eliminated the need for auxiliary support with extra-oral force.

A Discussion on the Advantages and Disadvantages of Fixed and Removable Appliances

Such a discussion will have to include many generalizations. In addition, it has to take into account the following factors which can exert a great deal of influence on the selection of any appliance:- (1) experience and training of the operator; (2) the psychological preparation, co-operation, age and constitution of the patient; (3) the severity of malocclusion and the

number of teeth involved in the planned movement; (4) the socio-economic pattern of the society and financial status of his parents; (5) the geographical factor (i.e. distance involved in seeking treatment).

Advantages of Removable Appliances (Active and Passive Types)

(1) Many of the advantages are readily seen. They are easier to make, less time consuming and enable the dentist to see more patients.

Removable appliances can be made in the laboratory, so the chairside-time is cut down considerably. Repair can be handled by the technician.

(2) Adjustments are less frequent. With judicious instructions, adjustments can be regulated by family dentists when distant patients are away from orthodontic specialists. According to Reading (81) the country patient is far better off in the care of his own dentist if the practitioner has the required experience and training.

(3) The construction is generally less complicated and is easily learnt. General practitioners are able to work with the specialists in the treatment of early or incipient malocclusions.

(4) The time for training operators is shortened for both specialists and general practitioners.

(5) The activator type of F.K.O. appliances are usually worn at night, and do not interfere with mastication or create an aesthetic problem.

(6) They are easy to keep clean, and do not present the same risk

as much as fixed appliances would in promoting decalcification or dental caries around the necks of tooth.

7. With the F.K.O. appliances, special advantages can be taken during the mixed dentition stage. The factor of anchorage is not a great problem with the F.K.O. appliances and the growth potential of the developing dentition is being utilized. With widening of the mid-palatal suture, two special advantages are claimed :-

1. overcrowding and lingually blocked out teeth can be corrected sometimes without further therapy.
2. Mouth breathing habit is corrected through the broadening of the base of the nasal cavity (34, 35).

(8) Alternations of thickness for adjustment of the F.K.O. appliances, and addition of attachments can be done quickly and easily with cold cure acrylic by the technician. Less demands are made upon the time and energy of the orthodontists than is in the case of fixed appliances.

It has been mentioned before that several movements in the three directions can be carried out simultaneously, and at the same time, the F.K.O. appliance can carry out alveolar movements of the teeth and influence the growth centres of the temporo-mandibular joint.

Disadvantages

The main drawback of all removable appliances is its removability. Good results are achieved only with total co-operation of the patients. The plates can be lost, and damaged.

Most of them, except the all metal Crozat appliance (used in the U.S.), are a bit bulky (35) and relatively hard to get used to, (23), and cause some interference in speech. As compared with the fixed appliances, their mechanical possibilities are unquestionably reduced (23). They do not have the control over the rotations of individual teeth, and selective group movements of teeth can only be carried out to a restricted degree. Not all cases can be treated by removable appliances and it is often necessary to 'round off' the final treatment with fixed appliance in order to get the desired results (54). With the F.K.O. appliance, Korkhaus (34) pointed out that the slowness of the alveolar movements in the expansion of the upper and lower arches is a definite disadvantage.

Another disadvantage he pointed out, is the difficulty encountered by mouth breathers in using the activator at night when the mouth-breathing is linked with an abnormally narrow nasal passage and a narrow palate. Korkhaus also mentioned that the activator is not advisable in locked bite, and also in Cl I cases (neutroclusion) where there is little autogenous force released by muscles reflexes.

Advantages of Fixed Appliances

Full control over individual teeth is maintained throughout the treatment period, and whilst the patient's co-operation is important in the matter of oral hygiene, it is not decisive regarding the final success. Treatment time is shorter in

some complicated cases as compared with removable appliances. Fixed appliances are more efficient in the correction of certain tooth movements of crowded incisors. They are not bulky and patients can get used to them in a relatively short time. Certain tooth movements can be seen after a relatively short treatment period, so that the patient's confidence and faith in the operator is enhanced, which in turn gives greater and better co-operation. In all but the simpler malocclusion, fixed appliances must produce the more precise result of all forms of orthodontic therapy.

Disadvantages of Fixed Appliances

The fixed appliance demands more time and effort of the orthodontist, and adjustments are more frequent and require the skill and judgment of a competent orthodontist. The orthodontist can only see a limited number of patients, from as low as 75 to 200 annually, as reported by a survey done in America (60). Treatment cost is more expensive.

Formal orthodontic training for fixed appliances requires more personal supervision, and more equipment. Unless adequate facilities are available, the training of orthodontists is often limited in number - a great disadvantage when there is a shortage of orthodontists in the country.

Certain fixed appliances are more obvious, and might present psychological barriers in appearance-conscious children.

For distant patients, the adjustment and repair of

orthodontic appliances constitutes a real problem when the journey to the orthodontist is long and time consuming. Another disadvantage is that general practitioners feel very hesitant in doing any adjustment work in fixed appliances for the distant patients away from orthodontists.

Another problem, which is preventable, is the decalcification and caries often found in the necks of teeth around bracket margins of fixed appliances.

Philosophy of Treatment

Having earlier discussed the American and European treatment approaches in their orthodontic problems, and the relative advantages and disadvantages of removable and fixed appliances, we may need to go one step further and find out if there is a basic approach to all orthodontic problems irrespective of the different 'systems' or 'philosophies' of appliances being used.

In Europe, the trend of orthodontic development has been along the line of removable appliances of the functional orthopaedic type. There are many variations and excellent results are produced. It is true to say that both fixed and removable types of orthodontic appliances are 'good' each in its own sense, and that no one appliance is neither infallible nor a 'cure-all' for all malocclusion cases.

Jorgensen (33) commenting on the application of activators said, "No universal appliance or system exists. The activator cannot be called universal, and it has disadvantages. However,

in the hands of an experienced orthodontist who really knows the philosophy, this is, as I stated earlier, a marvellous thing and the greatest importance in meeting the world's need for orthodontic help." And Moyers, (42) concluding his chapter on "A word about 'Systems' and 'Philosophies' ", says : "It is well to remember that any mechanism used today must have some merit or it would not have survived. Most modern orthodontic appliances have certain advantages and disadvantages which are unique to them and have their own individual appeal to the clinician... More experienced clinicians who have worked with several varied appliances are usually less dogmatic in their claims for a particular mechanism, even though they have strong personal preferences. No one appliance is infallible, or else thinking clinicians would have deserted all others." He went on to sum up the situation which bears the hallmark of a basic truth to all 'philosophies' : "Orthodontic appliances are good, not because of the ingenuity of the gadgetry, the clever vocalizations of their proponents or the eminence of their originators, but rather because the clever orthodontist may use them, within the physiologic limits of growth and developments, to achieve fine clinical results."

This view was shared by men with an insight into basic orthodontic principles. Professor Gugny said (54): "... every method gives good and poor results. The type of treatment used does not influence the result. It is mainly a matter of individual skill of the orthodontist." Supporting Professor Gugny's

statement, Professor Madame Mullen of France commented as follows, (54): "I agree with Dr. Gugny that the type of appliances is not important. More generally the orthodontist must take a clear idea of diagnosis, know the limitations of therapy in each case and be in possession of a variety of adequate techniques."

It is fair to assume that basically, the fundamental principles of orthodontics are the same, regardless of techniques; that they are all dealing with living tissues, governed under the same physiologico-mechanical principles.

The intelligent operator will handle his orthodontic cases only after careful case findings, detailed analysis and case evaluation, and then he would make his decision not because he is the master of his technique, but because he has acquired an understanding of the biological considerations, including growth and development, histological effects of tooth movements, and the limitations and possibilities of what his appliances can do in each individual case.

Criticizing some people who have undue bias and doubts they have for removable appliances, Fanning (80) comments : "This doubt should not exist; it is caused, undoubtedly, by unwillingness to study fundamentals, to put forth painstaking effort and thought in mastering principles. To apply any technique successfully, one must first have a thorough knowledge of elementary and advanced subject matter. ... Combined to form a

technique, their use need not be questioned. Their place in orthodontia and general dentistry is significant; they are true of purpose and of end results".

Dentistry, especially orthodontics, will make greater advances and gain greater stature if people can forget their petty jealousy, and biased opinions among themselves to determine what is the 'best' technique. Instead, they should channel their knowledge and efforts together, and conduct advanced work in many yet to be solved biological problems in growth and development, and train more young men to become orthodontic teachers and research workers in orthodontics. In this way, it is hoped that treatment and prevention of malocclusions would be more precise and definite and that orthodontic principles will be recognized and followed throughout in all phases of dental practice.

CHAPTER 9. ORTHODONTIC SERVICES FOR THE MASSES

It has been pointed out in the previous chapter that most European countries are incorporating orthodontics as an integral part of their general dental practice. The trend of thought is indirectly reflected by the training of their dental graduates, the ways the services are administered, and in the extent and aim of orthodontic treatments they hope for. In short, they regard orthodontic treatment not as a luxury reserved specially for a limited number of children who have well-to-do parents, but as a requisite for optimal dental health, being equally as essential and as important as good restorative work. This view was supported by Hotz (30) who said: "If orthodontic therapy is really necessary from a medical and dental point of view, then it must not be the privilege of favoured children. Then the indication is purely dental and medical and should include, if possible, all children with malocclusions."

It is therefore not surprising to find that most of the European general practitioners take up orthodontic cases in their routine practice, while advanced cases of malocclusion would be referred to practitioners with exclusive practice in orthodontics. The complementary relationship between the general practitioners and specialists works out well.

Holland

An orthodontic centre in Holland described by Dr. Ch.

F.L. Nord (46), is an example in which he regarded how orthodontic services could be offered to the general public economically and profitably, as well as in the interest of both parties.

He ran the clinic with three other orthodontists. They treated 1,500 patients each year, and had another 2,000 patients on the waiting list. The children were between the ages of seven and fourteen years. One of the main differences between this clinic and the American and Australian ones lies in the scale of treatment fees. All patients paid only a fractional amount of fee compared with the fees charged in the U.S. or in Australia. They paid £1.10.0 sterling for the first appointment, and 10/- for each month up to a maximum of at most two years. Dr. Nord stated that an efficient dentist could treat fifteen patients in an hour.

Most of his orthodontic therapies were found to be preventive and interceptive in nature, such as correction of pernicious oral habits, or creation of space for crowded teeth by expansion of arches during the deciduous and mixed dentition period. "The orthodontic treatment of the temporary teeth can be effected in most cases with very simple means and generally give quick results", said Dr. Nord.

Poland

Another example of successful orthodontic service for the masses, preventive in nature, was cited by Professor Dorminik,

of Poland (73). He reported that myotherapy alone plus some very simple removable appliances was sufficient to bring about 30% of complete cure in children with dentofacial anomalies. These children were very young, and spent the greater part of the day in kindergartens and nurseries, under supervision of the school staff and directions of a visiting trained nurse. An orthodontist visited the school with his nurse. Recommendations were made by him after initial examinations, and later periodic examinations were made at an interval of every two or three weeks. The nurse kept the records, and case histories of the progress of their young patients. Group myotherapy was generally carried out under the supervision of a teacher or a nurse. Those children who did not respond to treatment or only partial treatment was obtained, were treated in the main clinics for appliance therapy.

It is interesting to know that all clinical procedures and examinations were made as simple as possible, and full use was made of ancillary staff.

Britain.

The British orthodontic service is under the influence of the National Health Service, which provides free and comprehensive dental treatments to all school children. It is, therefore, understandable that all the treatment services are geared to provide for the 'masses'. In other words, they aim to reach a maximum number of patients as best as they can, with the present, though limited, resources of personnel. Orthodontic service

is of no exception.

Poulter (50), who gave a very good picture of the British orthodontic service in England in a recent article published in the Brit. D.J. March 1963, explained: "... it is essential that orthodontic services no matter what form they take, should be both clinically and administratively efficient."

As far as the British government is concerned, orthodontic services are generally encouraged, but on one condition, that they do not interfere too much with routine dental services. The Ministry of Education in 1955 expressed their view on the school orthodontic service, stated, in part, as follows: "... but not at the expense of ordinary conservative work."

The British Society for the Study of Orthodontics (B.S.S.O.) stated that an orthodontist working full time could deal with 250 cases of all types per year, and carry a total of 600 to 650 cases (50).

It was learnt from the discussion that immediately followed Poulter's article (50), that a full time orthodontist was not considered necessary on a regional dental service where the number of children did not exceed twelve thousand. It was felt that part-time orthodontic staff could deal with the situation.

As the allocation of funds is not unlimited, a measure

of control must be expected and this, in turn, must influence the type of service provided.

Orthodontic Services for the Masses in America

Socialized orthodontic services do not exist in America. The American dental profession is very concerned about any bureaucratic control at all, and it is strongly against all procedures that would bring in such a control of any form by the government. However, some form of organized orthodontic services is being provided in some cities as an extension of the general rehabilitation scheme designed for children with orthopaedic and other handicapping conditions. Such an orthodontic care program in the State of New York is a good illustration of this service, which can well be adopted by Australia.

The program (7) was instituted in 1944. It was originally designed for children with severe dentofacial deformities such as cleft palates and lips, and later it was expanded to cover severe malocclusions which might present serious handicaps to children in their normal physical and mental development, education, and future employment.

The Department of Health works in close association with the American Association of Orthodontists. For example, an Advisory Committee has been formed since as early as 1944 (7) and its chief functions were formulated with the help and co-operation of the Bureau of Maternal and Child Health of the State

Department of Health and with the Bureau of Dentistry of New York City.

Conditions are clearly laid down for the admission of children for treatment, and for orthodontists who could be doing the work. The criteria suggested by the Committee on Orthodontics for examination and acceptance of orthodontic care patients are as follows:

1. Malocclusions associated with cleft palate, cleft lip or ankylosis of the temporo-mandibular articulation.
2. Malocclusions resulting from severe structural deformities involving growth and development of the mandible and/or maxillae:-
 - (a) Prognathism
 - (b) Retrusion
 - (c) Micro or macro-development of the jaws.
3. Severe malocclusions resulting from disease or trauma of the mandible and/or maxillae.
4. Malocclusions resulting in disfigurement or speech defects which may present a serious obstacle to normal development, education and employment of the patient later in life.

The functions of the Advisory Committee are as follows:

1. To advise the Department concerning the classification of handicapping malocclusions and whether or not selected patients fit into this classification.
2. To advise the Department as to training and experience necessary to qualify orthodontists for participation in the state aid program, and to advise concerning qualifications of individual applicants.

3. To advise the Department concerning an equitable fee scale for orthodontic care.
4. To review selected cases at periodic intervals and to advise the Department concerning the progress of treatment.
5. To advise the Department as to orthodontic educational programs and material for professional personnel, including dentists, physicians, nurses, dental hygienists, and other interested health personnel.
6. To prepare instructions to orthodontists re progress of treatment, preparation of diagnostic aids, etc.

The orthodontic care program is looking after 3000 children a year at present, with an annual expenditure of about U.S. \$500,000.00 allocated for just this project, and with more than 200 orthodontists working on the panel.

Briefly, children are examined by private orthodontists, and examination reports with full-mouth X-rays and study casts are sent in to the Dental Bureau for approval of the State aid program. The Bureau will then determine the eligibility of the cases.

The judge of the Children's Court will then authorize permission for treatment, and will either make the cost a full charge against the County of his jurisdiction, or he may order part or full payment by the parents. Treatment may be provided by orthodontists on the Health Department's specialists' roster

only, and not more than one year of treatment may be authorised at a time, but the case is reviewed at the end of each year before treatment is permitted to commence again the next year. The maximum duration of treatment under this State aid program is three years. This program has been claimed to have great success (7).

The uniqueness in the New York program lies in the fact that the Orthodontic Society took a part in the initiation and development of policies and plans. The Government works closely with the profession, and the program is expanding because there are definite guide lines and criteria to abide with. It is a good example to be followed by other countries with the intention to adopt orthodontic care programs for children with dental facial handicaps, where there is no national or socialised dental service in existence. With modifications to suit the special socio-economic patterns and existing health services of the community, the ideas and principles of the New York State aid orthodontic care program should work out equally well in other communities.

Another community orthodontic service was reported by Dr. Wright (83) in Philadelphia. This service was completely organized by the Philadelphia Mouth Hygiene Association and financed locally without the U.S. Federal or State aid. The orthodontic program is made available to all children of indigent families. Family income is the determining factor for eligibility

for acceptance. Also, preference is given to children with most severe forms of dentofacial anomalies.

The clinic was manned by a number of qualified orthodontists who attended the clinic at least two mornings a week. Many children were able to obtain the orthodontic treatment through this community health service who otherwise would never be able to receive orthodontic treatment.

CHAPTER 10. THE PLACE OF ORTHODONTICS IN DENTAL PUBLIC HEALTH

There are strong suggestions that orthodontics should be included as an integrated program of dental public health activity. There should be no doubt about what orthodontics can offer towards the proper growth and development of children with respect to possible improvements in appearance, masticatory efficiency, speech and breathing, etc. Yet seldom has orthodontics been included in a dental public health program. Since dental health is an essential part of child health, and so much of this has to depend on the healthy development of the body and mind which can come from an aesthetic and functional dentition, the omission of orthodontistics in such programs seems hardly justified.

The lack of information on the magnitude of the malocclusion problems in the community plus the lack of objective criteria for classifying malocclusions, undoubtedly have hampered the progress in this aspect of public health activity. In addition, there are administrative and practical problems, too, which cannot find easy solution. Some of the problems would appear to be as follows:-

- (1) The cost of orthodontic care is considered to be too high in relation to other health services.
- (2) Unsympathetic government and insufficient money and personnel in the Dental Division of the Department of Health to man a good program.

- (3) It is not easy to reach a compromise on the extent and aim of treatment in view of the degree of perfection against cost and time.
- (4) Data on long-ranged clinical results of public orthodontic programs are not available. There are few existing pilot programs which could demonstrate the benefits and pitfalls of such a kind of orthodontic care program with regard to cost, staff, budget, evaluation, etc.
- (5) Retention period should be considered from the standpoint of length of time required, service to be rendered and costs involved.
- (6) Criteria for the acceptance of qualified operators must abide with professional ethics.
- (7) Poor response. , There is insufficient awareness of orthodontic benefits in many sections of the community. It is generally true that in any public health program, the response for service will be poor unless there is a felt need.
- (8) Specialists do not always identify their responsibility with problems that concern the public in general.
- (9) There is insufficient communication between the specialists and general practitioners regarding the prevention and interception of early orthodontic problems.
- (10) The actual number of qualified operators who can be delegated to do the job with respect to the magnitude of the population group who may need treatment.

Despite the many problems which may be introduced in

the initiation of a program of orthodontic care in the dental public health service, there have been certain principles suggested (20) which can be of help to us. In general, the principles can be divided into the following sections:-

- I. Education in the prevention and interception of malocclusions.
- II. Provision of immediate and long-ranged treatment programs, and
- III. Research and investigation.

I. Education in prevention and interception

- (a) Revise the curriculum of undergraduate orthodontic education. Give adequate training in orthodontic principles instead of techniques and skills.
- (b) Stimulate interest and promote communication between orthodontists and general practitioners, especially in matters concerning the areas in the prevention and interception of malocclusions.
- (c) Educate other health personnel to exert their influence to increase the awareness of orthodontic care and its benefits among parents and children.
- (d) Educate the general public of the importance and benefits of orthodontics.
- (e) Educate the public to remove any fear and misunderstanding about orthodontics.

II. Provision of Services.

- (a) Provide immediate service programs for children with severe

dentofacial or other forms of handicapping conditions through the establishment of central clinics and habilitation centres. The funds can come from the State's Department of Health, and be subsidised by Federal aid, and from the local community.

(b) Provide orthodontic consultant's services in big regional general hospitals and in some big country centres away from the capital cities. The orthodontic consultants thus employed should be paid for their service. The nature of their responsibility may be chiefly advisory. Patients can come on the referral of their dentist.

(c) Election of Advisory Committee from members of the state branch and Federal branch of Orthodontic societies. The Advisory Committee is to advise and co-operate with the local community and the government agencies on any short and long-ranged public orthodontic programs.

III. Research

(a) Research centres and pilot programs should be established with funds from the government for the purpose of investigating into all aspects of orthodontic science that would increase our comprehension with respect to diagnosis and treatment planning of malocclusions.

(b) Set up special committees to investigate into methods which may help to increase the general demand for orthodontic care and the efficiency of orthodontic practices.

(1) Remove the economic block for orthodontic services by developing suitable pre- and post-payment plans.

- (2) Promote the full use of auxillary and ancillary help in an orthodontic practice.
- (3) Investigate into techniques that would retain the quality of treatment results, and yet shorten the overall treatment time.

CHAPTER 11. THE GENERAL PRACTITIONER AND THE
ORTHODONTIC SPECIALIST

The very nature of the general practitioner's frequent contact with the general public has put them in an unique position to best handle prevention and interception of malocclusions. They are the key figures and the main stream in the very basic structure of orthodontic practice (3). From the chapter on the prevalence rate and incidence of malocclusions (Chapter 6), it has been pointed out that the prevalence rate of malocclusions is very high but as much as 80% of malocclusions is preventable. (73). The information provokes two thoughts. The first one reflects the hopeless situation in which the small number of orthodontists can neither supply the need nor meet the demand of orthodontic service. This situation will become worse when the supply of orthodontic specialists is not keeping pace with the increase of population. The second thought is a more hopeful one. It makes us think of the opportunity which can be opened up to the conscientious general practitioners who want to join in with the team of preventive orthodontics.

By virtue of his position as a specialist, the orthodontist seldom sees any malocclusion at its infancy and the bulk of his orthodontic cases comes from the many sad and neglected mouths, the mutilations of which could, in many instances, have been prevented from the very beginning by an intelligent and responsible general practitioner. Weber (66) commenting on the

role of the general practitioner says : "If reduction in the incidence of malocclusion is possible, (and almost every orthodontist would admit that it is), or if malocclusion cannot be entirely prevented and yet there is something that may be done to make it less of an aesthetic or functional handicap to the patient, and if there are services that the non-orthodontist (general practitioner) can render, then we already possess the potential for solving the problem of providing orthodontic assistance for the children who are presently without it."

Then, why is it the majority of the practitioners feel so hesitant in fulfilling their important role? What is their attitude towards orthodontics? Statistical data are lacking, but it seems safe to assume that their hesitancy and cold response to do preventive orthodontics may be due to the following factors:-

1. Feeling of inadequacy and lack of basic training in orthodontic principles.
2. Lack of information and knowledge in growth and development which is so necessary for one to recognise and detect deviations and incipient conditions of malocclusions.
3. Unhappy experiences of previous failures in attempts which result in bitterness and loss of time and effort. Emphasis on appliances and techniques will soon force the general practitioners to realise that 'moving a few teeth' would involve biological laws with which they are not well prepared to follow through.
4. A concept generally held that all things that deal with

malocclusions are to be treated by orthodontists, and not by 'amateurs'.

5. A concept that early recognition of incipient conditions is of no substantial help with respect to the final phase of treatment procedures, because some orthodontists do not start treatment until their malocclusion become fully formed anyway.
6. Lack of appreciation by some parents would put off a lot of enthusiasm and keenness in some general practitioner's attempts.
7. Lack of proper communication between the specialists and general practitioners. Lack of orthodontic consultants who would be prepared to direct and guide the general practitioners, in their efforts to try on some simple cases.
8. Feeling of apathy and indifference towards anything they do not know, including orthodontics.
9. Lack of finance in return for the work done when compared with other phases of dental treatment. 'It doesn't pay!' is a strong motive for some to keep away from doing preventive orthodontics.

In this world of specialization, the much harried general practitioner does not seem to occupy a definitive role in the grand stand of the dental profession. An often quoted comment made by Ellis in 1947 still holds good up to the present moment. He said: "The general practitioner is a much-abused and harried professional man. He is expected to be a good diagnostician, conservative operative dentist, prothodontist, periodontist,

endodontist, pedodontist, exodontist, preventive dentist, to have some knowledge of orthodontics, and an economist of sorts, at least that he may make adequate returns to the income tax authorities. All this the general practitioner is expected to accomplish in spite of the fact that his education has been a bit lopsided in favour of restorative technique. Indeed, he is truly one who knows 'less and less about more and more'."

The type of orthodontic education for the general practitioner received in his undergraduate days is important, and can have a decisive influence in his later interest in preventive orthodontic practice. Salzmann said (57) : "In order to educate the dentist you have to catch him young." The undergraduate orthodontic education will be discussed in Chapter 13.

However the orthodontic societies must demonstrate their leadership to bridge the invisible, yet discernible, gap that is now separating them from the general practitioners. This can be achieved in the following way :-

- (1) Communicate with the general practitioners by way of meetings, seminars, and postgraduate programs of short duration in their interest.
- (2) Encourage consultations made by general practitioners who either refer patients or want to improve their orthodontic understanding. Give adequate and detailed reports when patients are sent in for advice by their dentist (79).
- (3) Encourage editors to devote more space for articles on

interceptive orthodontics in dental literature.

- (4) Help and advise general practitioners on matters regarding the formation of orthodontic study clubs, or in the planning of regular orthodontic meetings.
- (5) Contribute effort and time to form an effective undergraduate orthodontic program.
- (6) Instruct general practitioners to do some of the tried and proved methods of treatment.
- (7) Show appreciation for the part the general practitioners play in the orthodontic team work.

CHAPTER 12. ORTHODONTIC RESOURCES AND EDUCATIONAL
OPPORTUNITIES

The impact of the shortage of orthodontic specialists is made more pronounced by the following factors:

- (1) Increasing demand of orthodontic service as the awareness of orthodontic benefits become more known by the general public.
- (2) More general dentists are more conscientious to give comprehensive dental treatment to their young patients and send them to orthodontists for consultation and treatment.
- (3) With the introduction of the prepayment and postpayment plans and other insurance schemes, many children can now gain access to specialist's treatment.
- (4) The resources and facilities to train orthodontists are limited. The ratio of orthodontists is fast deteriorating, and is getting worse with the rapid increase in the young population groups.
- (5) The concentrations of orthodontists in big cities have increased the complexity of the picture of meeting the demand and need for orthodontic service as a whole. Geographical isolation from orthodontists has deprived many children of the accessibility to receive orthodontic benefits.

The facilities and resources of orthodontic training in the United States, England and Australia will be discussed in

the following pages, and the ratios of orthodontists to population in these three countries will be compared.

(A). In America

A review of the recent American orthodontic literature will no doubt give one the impression that the American orthodontists are really concerned about their orthodontic problems regarding facilities for training and the number of new orthodontists they can produce in the near future. Graber's soul-searching article "Are orthodontic educational opportunities adequate" (25), is a masterpiece of its kind that the dental and orthodontic educators must read. Other fact-finding reports and informative articles can be found in Hollinshead's Survey of Dentistry (60) published in 1961, and Orthodontics in Mid-Century, (74) edited by Moyers and Day, published in 1959.

The revealing information of the rapid increase of the U.S. childrens' population of the orthodontic age group by Graber (25) is almost staggering. Graber's latest available statistical records disclose the following data:

- (i) There are 20 millions of children under 5 years of age, and 66 millions under the age of 18.
- (ii) 4 millions of babies are being born each year.
- (iii) There are 34 millions of children between the age of 5 and 13.
- (iv) There are 66 millions of children under 18 years of age.
- (v) By 1969 there will be 13 millions more children of the 10 and 19-year age group.

Number of orthodontists:

There are approximately 3,000 A.A.O. (American Association of Orthodontics) members in the exclusive practice of orthodontics. Most of these men practice in large cities, and the rural population is not being served well. The population per orthodontist varies broadly from state to state and among districts of the same state.

Based on the number of children between the ages of 5 and 14 years the average ratio is 18,910 children to one orthodontist. The range varies from 4,850 per orthodontist in the District of Columbia at the lowest limit to 119,667 per orthodontist in Arkansas at the other extreme, almost twenty-four times the difference of the former state.

There are two States, District of Columbia and Nevada with 4,850 and 6,333 children between 5 and 14 per orthodontist respectively; 17 States with figures between 10,000 and 20,000; 8 States with figures between 20,000 and 30,000; 13 States with figures between 30,000 and 40,000; 9 States with figures more than 40,000 and up to 119,000 in Arkansas.

Working on a higher age group, e.g. under 18 years of age, the figures in 1958 showed that there were 32 orthodontists per million children, or 31,250 children under 18 years of age per orthodontist.

Taking the population as a whole of all age groups,

the figures are alarmingly high. For example, in Arkansas the over-all state ratio is 1 to 222,613; the ratio goes down to: 1 to 52,963 for New York State and 1 to 46,400 for the New York City region; 1 to 72,859 for Illinois and 1 to 56,823 for the Chicago district; and the lowest district ratio is 1 to 21,200 in the North Platte district in the Omaha region. There are many regions or country centres with more than 100,000 persons and without orthodontists at all.

Number of Schools for Training Orthodontists

The number of schools that offer orthodontic graduate or postgraduate specialty training as from September 1963 is 38. This number would include Boston University (which does not have a dental school but gives courses in orthodontics), and the University of California (which has the Curriculum II program for a few selected students majoring in orthodontics in their undergraduate studies).

Orthodontic education can be obtained in one of the following ways:

1. Formal graduate programs.
2. Postgraduate programs.
3. Undergraduate orthodontic major programs supplemented by preceptorship (i.e. University of California Curriculum II program).
4. Rigid preceptor programs of the A.A.O.
5. Certain combinations of the above programs.

All of these methods of education have minimal time requirements set by the Board. The average length of a course is 22 months but of course lengths vary from 16 months to 30 months depending on the school. The preceptor programs are under a strict supervision of the Qualifying Committees of the A.A.O., and unless the decision is changed, no man will be admitted into the A.A.O. from the preceptorship (associateship) program as from July 1967. (77).

Graduate orthodontic programs consist of a planned sequence of courses leading to an advanced degree such as a M.S.D., or M.S., or Ph.D., granted by a recognized institution. The postgraduate program consists of a planned sequence of courses that does not lead to a degree, but enables the student to receive a certificate at his completion of the course (60). The clinical training received in both courses is the same, except that in the postgraduate course, the student is not required to submit a thesis of research or review as does the graduate student, and in some schools, the postgraduate course may be two or three months shorter than the graduate program. The number of students graduated in Orthodontics varies from one to twelve each calendar year. In 1962, the numbers of graduates from all the graduate and postgraduate programs was 243. There are 106 men who have taken the preceptorship training courses under the A.A.O., and about 25 men would complete the regulated programs each year. It is expected that by the end of 1965, the total number of students undertaking the graduate and postgraduate

programs would rise to a figure between 400 and 450.

At present, 29 States in the United States have no formal orthodontic training, and only 21 out of the 50 states plus the District of Columbia have orthodontic training facilities. But the resident preference rules exist in 13 out of these 21 states. In other words, only the institutions in the remaining 9 States in the U.S. would offer a chance of orthodontic training to people from other states of America or to people outside the country.

The selection of students is very stringent and the demand is very much in excess of supply. There are as many as 15 applicants to every available place in some schools. The usual percentage of applicants accepted from all who have applied is about 10. Only those applicants with high calibre and good records would be accepted.

The Preceptorship Program

The objective of the preceptorship program is to provide an opportunity for those who are unable to obtain a formal graduate or postgraduate orthodontic education in a university or dental school. Hopkins (78) has pointed out the advantages and disadvantages of the preceptorship training. Of the advantages, he lists the following five factors:-

1. The time factor.
2. The money factor.
3. Superior training facilities in several areas.

4. Preceptorships offer an additional opportunity for orthodontic training.
5. Personal factor.

The money factor and the time factor can be the very reasons that people would prefer to go into associationship with a senior partner. By so doing, the younger men can get into practice sooner, and can gradually build up their own practice. Although the demand for orthodontists is high, yet it takes a while for a young graduate orthodontist to get things really going if he is on his own; and then very often it is the only way that one can receive orthodontic education. The main disadvantages of such a program would fall upon one or a combination of the following factors.

- (1) There is no provision for basic science study, which is the weakest point in the program.
- (2) The abuse of the program can be a real one, if the preceptor's motive to take on a younger man for training is a selfish one - the "glorified slave labour" (25) who would do all the heavy work for his own profit.
- (3) Personal character clashes between the senior partner and the young associate can result in bitterness and disappointment for both parties.

Curriculum II Program

The California Curriculum II program is designed to give orthodontic training equal to the postgraduate standard to some selected students (six in number) during their undergraduate

course. The program has been in existence just over 30 years, and it has been the impression of many that men graduated from such training are as equally competent orthodontists as others. The selected students are given special training in orthodontics from their second year onwards of their four-year course until their graduation. They attend the undergraduate curriculum almost the same as the other students, but their laboratory work in prosthetics etc. is cut down once they show their proficiency. They concentrate on orthodontic problems while other students are busy with conservative or prosthetic dentistry. But it is the opinion of many educators (74) that this should not be the desirable pattern for other schools to follow. The current accepted philosophy is to prepare an all-round dental graduates for general practice in the first place, and to let them enter specialization afterwards.

(B) In England

The scene of the British orthodontic resources and educational opportunities is different from the one we have seen in America. The divergence in the patterns of development and practice teaching of orthodontics can, to a large extent, be accounted for by virtue of the fact that these two countries have a very different socio-economic pattern plus the fact that the British National Health Scheme has both indirectly and directly altered the course of the dental and orthodontic practices in England.

In England, the University of London has a dental school attached to each of the following Teaching Hospitals: (1) Guy's Hospital, (2) King's College Hospital, (3) Royal Dental Hospital, (4) University College Hospital and (5) London Hospital. In addition, there is the Postgraduate Institute of Dental Surgery at Eastman Dental Hospital. There are dental schools in the Universities of Birmingham, Bristol, Leeds, Liverpool, Manchester, Durham and Sheffield. In Scotland, there are three dental schools, St. Andrews (at Dundee), Edinburgh and Glasgow. In Northern Ireland, there is the Queen's University of Belfast. In Eire, there are two dental schools, one in Dublin and one in Cork. Diplomas in orthodontics (D.Orthodontics, R.C.S.) are awarded by the Royal College of Surgeons of England, and an equivalent orthodontic diploma - the Diploma in Dental Orthopaedics (D.D.O.), is awarded by the Royal Faculty of Physicians and Surgeons of Glasgow.

Orthodontic training in England can be obtained in Universities and dental departments in general hospitals recognized for the purpose of orthodontic training by the Royal College of Surgeons, and the Faculty of Physicians and Surgeons of Glasgow.

The requirements for the D.D.O. and D.Orth. R.C.S. are slightly different, but the general principles are the same. Both require that the candidates must have been previously engaged in full-time orthodontic practice for at least one year in a recognized hospital or institution approved by these two institutions.

In additions, the candidate must have six months experience of general dental hospital training as well. Candidates for the D.Orth. R.C.S. are required to pass the primary examination of the F.D.S. diploma before they can sit for their orthodontic examination. Their basic training is emphasized on applied biological science, such as applied anatomy, physiology, embryology with special applications to the science of orthodontics.

Quite a number of dental schools in Britain offer long and short courses in orthodontics. The long courses are usually of one year's duration and the short courses range from a period of one or two weeks up to eight weeks.

The General Dental Council has listed 12 institutions and hospitals where orthodontic teaching facilities are offered. However, it is believed that some more places are available, but these are not mentioned in the Council's booklet "Facilities for Dental Postgraduate study in the United Kingdom", since these institutions do not wish to increase the number of applications for their courses.*

A student of orthodontics who is working in a hospital under training is eligible for a paid appointment of the range of £650 a year for a junior clinical assistant appointment. Higher scale of salaries are offered to more senior men.

The numbers of candidates who have received the D.D.O.

* Private correspondence.

and the D.Orth. diplomas in 1960, 1961 and 1962, are 29, 19 and 29 respectively.* The latest figures recorded from the 1962 Orthodontic Directory of the World shows that in England and Wales there are 170 men with orthodontic qualifications. In Ireland there are 21 practising orthodontists.

It is assumed that many of these men would be working as orthodontic consultants in the school dental services or in hospitals, or just as general practitioners. The number of patients they see each year would be far greater than the American orthodontists. Also, many of the patients who need orthodontic treatment are carried out by general dentists who are interested in orthodontics, and may be under the guidance and supervision of an orthodontic consultant.

(C) In Australia

The situation in Australia is very different from either of the American or the English scene. Geographically isolated, any away from the main world orthodontic centres, Australia appears to have developed a broad orthodontic approach to the various schools of thought. However, the trend of progress is running very much in the same direction as the American development. Although, admittedly, the orthodontic profession here in Australia has a shorter history, its impact on the teaching and practice of dentistry, though continuing and improving, is not

* Private correspondence.

as great as it should have been. This is understandable when the facilities in postgraduate orthodontic education are so much hampered by the lack of teaching staff, space, equipment, and finance. There is no formal graduate or postgraduate orthodontic education in Australia at the present moment. The Orthodontic Department of the Sydney University has been conducting a postgraduate course one morning session per fortnight for two years for general practitioners who are interested in orthodontics. The completion of the course does not lead to any degree. The total number of men under training now is about 20 under the supervision of the Head of the Orthodontic Department, and several other practising orthodontists. The University of Melbourne conducted a formal course in orthodontics several years ago but it has been discontinued since then.

Without going into the detail of treatment methods and philosophies, it is not over-presumptuous to state that Australia is more inclined towards fixed appliances on the whole, and that the Edgewise and Begg's light wire technique are the two main lines of orthodontic practice.

The ratio of population per orthodontist in Australia is far from an enviable one. Worse still, the ratio is deteriorating as there is a rapid increase of young population group. With little prospect of increasing the present facilities to turn out qualified orthodontic specialists in the near future, the dilemma of orthodontic education in Australia is a real one.

With a population of eleven millions of people, sixty orthodontists are working in the exclusive practice of orthodontics in five states in Australia. The majority of them practise in the capital cities and a fair number of large country centres away from the capital cities are not served by orthodontics at all.

A great proportion of child population in country towns and smaller townships would never be able to benefit from orthodontic treatments unless they can afford to make the long journey, time and money.

More children are born each year, and the birth rate is at 2.4% of the present population (or 24 live births for 1000 persons in a year). Unless the different dental schools would consider special orthodontic training for their graduates, there is very little hope that the large number of children in need of orthodontic attention would ever be able to receive adequate orthodontic treatment in time at all.

The following table gives an indication of the distribution of orthodontists in different States and capital cities in Australia.

States	Capital City	Population	Orthodontists	Ratio of one orthodontist to population
N. S. W.	Sydney	4,048,598 2,215,970		
Victoria	Melbourne	3,055,731 1,956,400		
South Australia	Adelaide	1,008,994 635,500	6 6	1: 17,000 1:106,000
Queensland	Brisbane	1,566,218 593,500		
Western Australia	Perth	772,566 431,000		
Tasmania	Hobart	361,320 188,828	1	1:361,320
Northern Territories	Darwin	29,424 4,700	none	
A. C. T.	Canberra	73,453 63,313	1	1: 73,453

Total population: 11 millions

Total number of orthodontists : 60

Ratio of one orthodontist to population: 1:183,000
of all age groups

CHAPTER 13. STATUS QUO OF ORTHODONTIC EDUCATION

Undergraduate Orthodontic Education

Undergraduate orthodontic education is a most challenging and stimulating issue for the orthodontic teachers. But it is equally controversial, confusing at times and thought-provoking as anything can be for them to tackle.

The reason why it is challenging and stimulating is due to the fact that here is an opportunity for the orthodontic teachers to develop his imagination and creative thinking in the planning of a successful program for the undergraduates. Cheney (12) expressed his view on this aspect of orthodontic education and said, "Since no undergraduate orthodontic training program has attained sufficient success to be adopted as a standard, orthodontic teaching in all schools has been experimental in nature. All sorts of programs have been tried and recommended."

The reason why undergraduate orthodontic education is controversial and confusing is because there are certain orthodontic educators (9, 40, 52) who insist that orthodontics should not be taught at all under its present undergraduate curricula, while others (12, 26, 44, 66) strongly feel that not only orthodontics should be taught in dental schools, but also it should be expanded and enlarged from their present scope.

Orthodontics differs from other dental subjects in that

it was started off at the graduate level. For a long time, it had been regarded as a secondary subject of slight importance in the undergraduate curriculum and with few exceptions, only a token effort has been made to establish an effective undergraduate program.

The situation at the present moment is such that Graber (25) was forced to express his opinion in the following manner: "Orthodontic education is in a critical state now. Unless we institute prompt remedies with strong recommendations as to curriculum, course hours, facilities, etc., we shall lose control of undergraduate orthodontic teaching. ... If we are not going to do the job, someone else will." This graphic, but unfortunately true, personification of the problem would represent the universal opinion of concerned orthodontic educators. Orthodontic undergraduate education has been in a state similar to Mark Twain's weather, "Everybody talked about it, but nobody did very much about it" lamented another (12). It seems it is high time that orthodontic undergraduate education will need a lot of vigorous reform and new stimuli with vital challenge.

It is often heard that dental students are indifferent and even apathetic towards orthodontic lectures and techniques. But they are not to be blamed if the orthodontic teacher fails to convince them that orthodontics is not just for the specialists only, but also a subject which has daily application in the routine practice of dentistry, and which they will be frequently called

upon to give advice and judgment. Having failed to be guided in the right direction, most students accept the study of orthodontics only because it is a requirement that they must pass in order to graduate. They cannot see why orthodontic principles should have a great impact on their practice as general practitioners later on. There seems to be no correlation in what they learn from the token lip service of a few lectures here and there with their future clinical applications. In other words, they have no enthusiasm and eagerness to learn orthodontics other than to fulfil the academic requirements. What they learn they seldom digest and assimilate into their practice. By the time they graduate, the young practitioners would often find that they are miserably inadequate and ill-prepared for orthodontic reasoning when they see malocclusion face to face. "They have been exposed to anatomy, physiology, histology, chemistry, etc., but have never learnt them" lamented Brodie (9).

A lot of discussions, essays and seminars have been contributed in recent years by dental educators on how the undergraduate orthodontic curriculum should be run (12, 10, 26, 44, 67, 74). Several conclusions seem to have crystallized and should bear fruits if they are put into practice. These concern the following issues: the importance in teaching basic science to the students, the correlation of their applications in clinical practice, and the relative role of technical work in teaching, and the objectives of undergraduate orthodontic education.

We have discussed in the previous chapters that a thorough grounding in basic orthodontic principles and biomechanical laws, and a profound knowledge in growth and development are essential for intelligent diagnosis, prevention and treatment of malocclusion. The emphasis placed on 'techniques' or 'systems of appliances' before basic reasoning cannot help but result in dismal failures. Techniques are secondary, and are mere servants to principles. Instead of placing importance on 'how' to bend wires, or 'how' to do a space maintainer, etc., the emphasis should be substituted by questions like 'when' and 'where' should one start to do things for patients, and 'what' should be done, and 'why?' (66) Commenting on an often asked question ' "How to treat" a malocclusion?', Brodie (9) said, "This is the technical and simplest part of orthodontics and can be taught in three months. What should be done and when it should be done are the important question, but these can be answered only by study and observation." He concluded: "Dentistry's need is for greater scholarship, not greater craftsmanship". Indeed, that is the very way it should be.

Weber (66) suggested that the important objectives in teaching is not to train all the students to become clinical orthodontists, but to be more orthodontically oriented towards their young patients.

Campbell (10) stated that the undergraduate orthodontic course should be designed with the ultimate purpose of main-

taining uniformity and correlation in teaching of foundation subjects. He further emphasized that lectures should be progressive and stimulating rather than a stodgy presentation of facts.

Basic or foundation subjects should have a close liaison with clinical orthodontic observation and teaching. Theories and experience should be an integral part of teaching. Not only the course would be more meaningful and interesting to the students but it also enables them to develop a deeper perspective in their field of work. Thus, they are able to look beyond the patient's mouth and teeth and to aim at the balance and harmony of the whole dentofacial structures. Their vision would become broadened, and their interest sustained.

However, concentration on basic science alone without clinical teaching is doomed to fail. This view was expressed by Cheney (12), who said, "Clinical experience is a necessary part of undergraduate orthodontic training. Our recent surveys of student reactions indicate that a technic course has no meaning and the lectures on basic principles are ignored unless these principles are applied to patient problems."

The objectives of undergraduate orthodontic education recommended by the 1951 Report of the Committee on Education of the American Association of Orthodontists (74) are still valid in current thinking, and should serve as a guide for dental

educators to form their own curriculum. They are as follows:-

1. To anticipate and detect malocclusion
2. To take steps to prevent or intercept malocclusions where possible.
3. To treat simple cases or the simple immediate problems of complex cases.
4. To use this knowledge as an adjunct to procedures in all other phases of dental practice.
5. To know what cases to avoid and refer to more experienced men in the field.

In addition, the committee recommended that 300 hours would be required to attain these objectives.

There are distinct advantages where the objectives of undergraduate orthodontic education are thoroughly taught to the students. Thus they know what they should do and can do with competence. They can prevent and intercept malocclusions though they themselves are neither expert diagnosticians nor experienced clinicians. They can contribute positively to the reduction of the prevalence and severity of malocclusions. They can promote better co-operation with orthodontists who, in turn, should recognise and appreciate their significance in the orthodontic team. On the other hand, thorough teaching of orthodontic principles would also reduce the requirements and time for extensive clinical and technical experience.

The course lengths and subject matters should be developed along with the objectives in mind, but major emphasis should be placed on diagnostic lectures, seminars, clinical observations,

case analysis and treatment planning.

The 300 hours recommended in the Report should serve as a guide, and need not be followed rigidly. Flexibility in time schedule and time conservation can be gained by not repeating subjects which have been covered elsewhere. It is better to demonstrate their application as often as possible in all clinical sessions throughout the course of dentistry to the end that the objectives of undergraduate orthodontic education can be met with satisfaction.

Graduate Orthodontic Education

The objectives and aims of graduate or postgraduate orthodontic education are different from those of the undergraduate orthodontic education. In addition to developing the students from a good foundation in basic subjects, the primary objectives of the higher orthodontic education would have to produce competent clinicians, and to prepare the students in a teaching career or in research work in the second place.

A sound orthodontic education should be designed to help the student to develop an ever-broadening vision in his work, and to increase his capacity in comprehension and in the manipulation of ideas, and to create in him an intelligent and analytical thinking. The final product of the education is a competent clinician with keen perception and a progressive mind.

However, against all these high idealisms, one should

be more realistic, to take stock, as it were, of the difficulties and dilemmas which are now confronting the dental educators in orthodontic education. There is a multiple number of reasons for making it so hard to administer an ideal orthodontic training. Briefly, money, teachers, physical facilities and the course itself are the major ones (25).

Money. All orthodontic teachers are relatively poorly paid. In the field of orthodontics where the pressure for private practice is high, and remuneration is good, a man can do so much better outside than to take up a teaching job. Graber very pointedly criticised "... involved in petty jealousies and politics that sometimes rears its ugly head in educational institutions". (25).

Teachers. Competent clinicians may not be good teachers. Many of them are not trained to be teachers. Without going into detail, teachers most suited for the purpose of high orthodontic education would be those who are academically qualified, and who have the faculty to guide and develop the students' ability in organized thinking and independent search for knowledge as well as to improve their technical ability. Good teachers are those who really know how to apply the principle: "Students are not vessels to be filled, but fires to be kindled".

Physical facilities. In most of the dental schools these are inadequate. Graber (25) has given a good account of the minimal physical facilities in a graduate orthodontic department. The

physical facilities are, although important, less nominal and should be secondary to devoted teachers and good spirit of learning.

The course should be designed so as to fulfil the educational objectives within its framework. The Workshop in Orthodontics (74) recommended a graduate program of a minimum eighteen months and twenty-four months as the ideal course length. They also recommended a total of about 3000 clock hours for the graduate curriculum, 1035 clock hours for required subjects, 150 hours for elective subjects and 1800 clock hours for clinical and laboratory sessions.

An editorial of the November 1962 issue of the American Journal of Orthodontics, commenting on the course design and course contents, has given an excellent account of a sense of proportion in what should be done. It says :-

"An orthodontic program should be designed to provide an educational experience for the student rather than be limited to technical or vocational training. Its goal should be to produce a clinician capable of thinking critically and analytically for himself, rather than depending upon set formulas for solutions to his clinical problems. Subject matter should be secondary to method of treatment. Any subject taught with proper educational discipline - i.e. stressing learning, collecting data, evaluating, analyzing, discussing, and critically reviewing everything that is read, heard or observed - will produce the desired product in

the student.

"The orthodontic curriculum may be arbitrarily divided into two parts, the primary or essential portion of the curriculum would include that subject matter indispensable to the production of a competent orthodontic clinician. The secondary or supporting portion of the curriculum would contribute to rounding out the student's educational experience and developing his ability to think critically and independently."

Training of Orthodontic Teachers and Research Workers

In recent years, some dental educators have expressed their conviction that it is necessary to give more time and opportunity for the students who wish to become future orthodontic teachers or research workers. The twenty-two or twenty-four months of their course are sufficient to prepare them to become competent clinicians, but not sufficient for training them to become teachers, or research workers.

Alton Moore, Dean of the University of Washington Dental School in Seattle, comments on this, saying (74) : "As orthodontic programs are now constituted, there is sufficient time available only to introduce the student to research methodology and techniques, let alone prepare him for a teaching and/or research career. In effect, the completion of such a program may be interpreted as meaning that the student has finished his undergraduate work in orthodontics and is now ready to embark on

a graduate program. Such a graduate program should be heavily laden with basic science and original research, with little time in clinical activities. It would require a minimum of 1 year for completion. The reward could then justly be labelled a Master of Science degree." Dr. Robinson, (53) Dean of the University of Kansas City School of Dentistry, in agreement with Moore, says: "The graduate degree has certain academic requirements which contribute more to the development of the teacher or researcher than to the development of a specialist in an area of dental practice."

In the University of Oregon, students who want to pursue the graduate program can gain admission by examinations during the first year, and thereafter they will be specially given opportunities to gain research experience and do special projects. They receive the clinical training at the same time, but conservation of time is achieved through the judicious use of auxilliary help. (75)

In the University of Washington, plans have already been designed to add one more year after the original two years of certificate course for those who want to do research and teaching later on (74).

The same arrangement exists in Kansas (53). A Graduate Orthodontic Diploma is awarded to those who have attained the

proper operative skill and the graduate degree M.S. is awarded to those who have acquired additional academic accomplishments.

It seems this is the most profitable way to train orthodontic students who want to devote their future career in research or teaching by giving them a solid grounding in basic science and research methodology during their graduate course. But whether the certificate or diploma would be acceptable to students whose primary motive is to become clinicians, and who have already put in two years for specialising in one subject alone, is too early to know. However, the principle underlying the distinction between clinical efficiency and academic proficiency is right. But if the significance of the certificate is recognized, and means what it is really for, then there is no reason why a healthy certificate program should be mistaken for a second class training, as now existing in some quarters. For such a certificate recognizes different talents and skills from the academic M.S. degree.

CHAPTER 14. DISCUSSION ON CERTAIN PRINCIPLES OF ACTIVITIES
APPLICABLE IN AUSTRALIA

There is no easy solution for Australia in solving her orthodontic problems. One of the main obstacles is money, or the lack of it; the second is money, and the third is still money. Provided that there is sufficient funds for a continuous budget, there is very little one can do to alleviate the present crisis concerning the shortage of orthodontic man-power and the poverty of the orthodontic care program in dental public health activities.

In view of the large number of unfilled decayed teeth in children's mouths and the even more pressing need for continuous incremental dental care for them (6), the order of priorities in a dental care program in Australia should start with the prevention of dental decay, followed by a more comprehensive treatment scheme for pre-and school children, in which the restoration of decayed primary and permanent teeth would take a high priority.

Fluoridation of water has been proved to be the most efficient, practical and economic preventive measure against caries. Unless there is sufficient control over the dental caries problem, the dental profession will continue to chase hopelessly after decayed teeth from mouth to mouth. Mutilations of dentition and tragic cases of malocclusion will continue to multiply due to

either untimely dental treatment or the negligence to seek any treatment at all.

With regard to prevention and interception of malocclusion, the general practitioners can do a good deal in the orthodontic team with the specialists. But prior to this, is required the careful planning of a vigorous educational program for both the practising dentists and the undergraduates. There is no one better qualified than the orthodontic member to initiate and conduct such a program. At present, there is insufficient communication and co-operation among general practitioners and orthodontists. Their relative roles of importance in this united orthodontic team have received great emphasis in Chapters 1, 9, 10 and 11 of this review. It is hoped that the reader will agree that greater attention should be placed on the education of fundamental orthodontic principles rather than the actual construction of orthodontic appliances.

If all the general practitioners in Australia were re-educated to orientate their thoughts and treatment procedures in accordance with orthodontic principles, the battle of prevention and interception of malocclusion would be half won.

The re-education of the practising dentists would doubtless be harder to achieve, and would take longer, but nevertheless, much can be done through well-organized postgraduate programs, seminars and meetings, or through scientific journals and other media of communication.

The idea of an orthodontic consultant's service is most welcome and should be put into practice as soon as possible, at least for a trial period. The best promotion in the relationship of these teams seems to be found in an adequate and detailed case report with judicious instructions returned from the specialist to the practising dentists, when patients are sent in for advice, provided of course, that the dentists also in turn give the orthodontists full case histories with all the necessary diagnostic data of their patients.

With a well integrated undergraduate orthodontic education, many young dentists might be challenged and won over to take immense pride in the overall and comprehensive dental care of their child patients.

The most urgent issue in orthodontic education in Australia seems to be the problem of recruiting sufficient numbers of competent and dedicated orthodontic teachers who are adequately experienced in basic biologic science as well as preventive orthodontics. This is preferable to their just being competent clinicians, with inadequate understanding of foundation subjects, and lack of interest in teaching orthodontics other than the construction of space maintainers or bite-raising appliances.

Graduate orthodontic education is the only avenue whereby we hope to produce competent clinicians with scientific thinking. This aspect of dental education has not been fully developed in Australia and is greatly lagging behind the Northern America,

Europe and England. The present situation of orthodontists/ population ratio will continue to deteriorate from the figure of one orthodontist to 183,000 persons (see Chapter 12, Orthodontic Resources in Australia) unless there is some immediate constructive scheme for action. Money, teachers, physical facilities and the length of the course would appear to be the four main conditions which hamper the progress of orthodontic education here in Australia as is the case in the U.S. now.

The situation is indeed serious, but the development of a graduate orthodontic program should not be a shot-gun procedure. A well-planned scheme is necessary, with clearly stated long and short ranged objectives and consideration for immediate and future prospects of the profession and the welfare of the community. It was a wise move on the part of the authorities last year to finally reject the plan for a one year course for a diploma in orthodontics in the University of Sydney.

Ideally the Dental school in each State should develop its own graduate orthodontic program, but if this is impossible at the moment due to the lack of money and other problems, then at least one graduate school should be set up in Australia, preferably in Sydney or Melbourne as a pilot program for later development in other States.

The course length should be at least of a minimum of two academic years or eighteen months, but it would be better to

extend it to 24 months. It is usually felt that the students would gain far greater benefit in the last 4 months than they would have in the first eight months. They would develop a better insight and have time to assess the results of their completed cases.

Although the primary objective in graduate orthodontic education is to produce competent orthodontists, it must be remembered that it is equally important to stress the need for producing research workers and future orthodontic teachers.

If no scholarship could be made available to post-graduate students to do the course, a similar policy like the British system should be attempted. In England, full time post-graduate students working in hospitals as junior or senior registrarships will get £650 sterling and onwards a year.

Another avenue for financing postgraduate students might possibly be the State Department of Health if it can be persuaded to offer fellowships to students who agree to work for a certain period of time after their training. The graduate orthodontists could work in Dental Hospitals, or as consultants to their Department, or even as consultants for practising dentists. Since the consultant's service is well developed in the medical profession, there is strong reason to believe that this may also be successful in the dental profession, especially in the field of orthodontics.

There is no positive solution for the distant country

patients, except perhaps that the local practising dentist, if there is any, should be encouraged by the orthodontic society to take a realistic view towards the orthodontic problems of their patients, and to make consultations with orthodontists by sending in good case histories and study models of their patients for examination.

Children from indigent families who have severe malocclusions or clefts should be helped by the government in the seeking of orthodontic and other related dental and medical treatments. An orthodontic care program like the one in New York State is worth looking into for experimental purposes here in Australia. The orthodontic society should work in close co-operation with the government. In all circumstances, the members of the Orthodontic Societies must take up the initiative and leadership.

CHAPTER 15. GENERAL SUMMARY

The task of prevention and interception of malocclusion would fall largely upon the hands of practising dentists, who have a unique opportunity whereby they can constantly observe and work on the developing dentitions of their young patients. To do so, they must have adequate training and knowledge to appraise and analyse case findings intelligently. At present, this knowledge is grossly lacking in many of them.

However, in recent years there has been an awakening interest in many concerned dental educators, who consider this grave problem of malocclusion in the community must be tackled by means of prevention and early interception, and that the general practitioners should take up the responsibility of dental guardianship for their child patients. Thus they should be given a thorough preparation for their future work during their undergraduate orthodontic education.

In view of the mutual benefits, general practitioners must orientate their thinking in accordance with principles of comprehensive dental welfare for their patients and adopt an "orthodontic sense" throughout their treatment procedures.

2. Heredity, function and environment are the three most important etiologic factors in malocclusion. At present, there is insufficient knowledge about the part played by heredity.

Fortunately our knowledge of the part played by environment and function in the etiology is adequate enough to enable us to institute limited but successful preventive orthodontic procedures.

3. The Angle classification, inadequate as it is, still enjoys high popularity because the classification is simple, practical and easy to use. The Simon System provides a better relationship between the dentition and facial skeleton, but it has the disadvantage of being more complicated and confusing, at times. However, a classification must not be taken as an end in itself, or be used as a substitute for careful examination and differential diagnosis.

4. The criteria for an occlusal index are very stringent and it is difficult to devise an index system with all the necessary features to comply with the requirements.

5. Five main forms of occlusal indices have been used in surveys. Some are based on purely subjective judgment such as the need for treatment, some on Angle classification or its modification, and some on measurements made by simple measuring instruments or dentofacial orthometer.

6. There is a high prevalence of malocclusion in almost every civilized country. The most prevalent type is found to be Cl I Angle malocclusion. Fluoridation and preservation of deciduous teeth appear to be the most effective means in reducing the

rate of malocclusion in a community.

7. Comparing the merits of the European and American views on orthodontic practices, Australia should adopt a happy compromise between the views of these two countries.

8. Removable and fixed appliances provide their relative contributions in orthodontic practices. Their usefulness is greatest, when the operator is familiar with their possibilities and limitations, and has a high respect for biologic principles under which an appliance is to operate.

9. Orthodontic services should be made available to as many children as possible, and should not be a luxury enjoyed only by privileged families. However, the form of presenting such services should conform to the local cultural and socio-economic background of the community. The services should be maintained at a high standard, and must not violate principles of professional ethics.

10. Orthodontics in dental public health activities can take three forms:

- i. Education in prevention and interception of malocclusion;
- ii. Provision of treatment programs and
- iii. Research and investigation.

Priorities must be assigned according to the needs and demands for treatment, and to available resources in finance and personnel.

11. General practitioners can be re-educated to take an active responsibility in the team of preventive and interceptive orthodontics. There should be more communication between general practitioners and orthodontists.

12. Orthodontic educational opportunities and manpower are inadequate to meet the demand. Urgent action should be taken to start some formal graduate orthodontic programs. Preceptorship training and Curriculum II programs are considered to be inferior to formal graduate or postgraduate courses.

13. Undergraduate and graduate orthodontic education have similar nominators, but different levels of objectives. Undergraduate orthodontic education must have clear and definite aims and objectives for students to follow. Suggestions have been made that special training programs be given to students who would devote their future to research and teaching.

14. A brief discussion on certain principles of activities that can be applied under Australian conditions has revealed the need for experimentation to start a graduate orthodontic school either in Sydney or Melbourne. It is hoped that the Australian Orthodontic Societies and the government will participate more actively in sponsoring orthodontic services.

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