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SPACE MAINTAINERS IN PAEDIATRIC DENTISTRY

KAMAL CHELVAKUMARAN ABDULLAH

BDS (MYSORE)

A THESIS SUBMITTED IN PARTIAL REQUIREMENT FOR THE
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SUMMARY

Dentistry in developed countries in the twentieth century has attained such great heights that presently many individual specialities are being sought after. Myself coming from a developing country and during the course of my work, have many a time come across patients both male and female between the ages of 10 to 16 years coming to seek advice on crowding of teeth affecting them both functionally and aesthetically. On analysis of these patients, it was realised that, the crowding in most of these patients was as a result of dental neglect, thus resulting in premature loss of their deciduous teeth. In view of this, it has prompted me to review literature on space maintainers in Paediatric Dentistry and the bearing of premature loss of deciduous teeth.

When the child initially comes for dental examination, the practitioner must attempt to evaluate each parents attitude towards Dental Health. If it is negative, he should attempt to improve it by motivation and education. Since the effects of space loss are most extreme prior to the completed eruption of the first permanent molar, every effort should be made to conserve the primary molars in a child under 7 years of age. However, when a child presents with primary molars that are candidates for extraction the effects of premature loss on the developing occlusion must be considered. When extractions are unavoidable, compensating and balancing extractions of other primary molars must be considered.
In cases where primary molars are unavoidable and compensation and balancing extractions are doubtful, the use of space maintainers should be considered. Space maintainers have the same ability to maintain symmetry in an arch. There will never be uniform agreement on the value of space maintainers, they do have a definitive place in paediatric dentistry. The problems they pose can be minimised by correct planning, construction and supervision of the appliance. Those who are experienced with their use tend to advocate them while those who are skilled in correcting the malocclusion that develops from early loss of primary molars tend to deprecate them. The final decision must be made with the best interest of the child at heart and not the ability or whims of the dentist at heart.

Space maintainers bearing in mind will do less harm than routinely not placing them are indicated in the following situations:

a. When a second primary molar is lost before the second premolar is ready to take its place.
b. Constantly review cases with premature loss of first primary molar and decide if a space maintainer will be useful.
c. In cases of congenitally missing second premolars.
d. Early loss of anterior primary teeth should be remedied by the placement of space maintainers.
e. In cases when the first permanent molar is lost several years before the eruption of the second permanent molar.
In the above situations the space maintainers indicated are of the passive type. In cases, through roentgenography, where it is found that there is not enough room for the lower second premolar to erupt or when the first premolar is slanting distally an active space maintainer will be useful.

Other factors which should be considered before the use of a space maintainer will be tooth loss and time of loss, number of teeth lost, the amount of bone overlying the crown of an erupting molar or premolar, the dental age of the patient, sequence of eruption of teeth, congenital absence of permanent tooth and the presentation of the problem to the parents. After a careful evaluation of the patients a good general and local examination of the patient must be done. The appliance should be simple to construct, and it must not cause any injury to the abutment teeth or soft tissues. The retainer should prevent overeruption of teeth in the opposing arch. The retainer may be fixed or removable, depending upon the length of time it is to be worn and upon economic considerations. The thirteen different types of space maintainers are described in detail in the thesis.

On the various studies done on the significance of premature loss of deciduous teeth (Chapter 4) it cannot be denied that premature loss of deciduous teeth does cause space closure to varying extents and is the main cause of crowding of permanent teeth. Looking at it in depth, deciduous teeth as nature's space maintainers, should be given much emphasis and as the writer has said, by maintaining them in place, it will place the child in no jeopardy.
The writer on his conclusion would emphasise that as far as possible, deciduous teeth must at all times be given conservative treatment and extraction on them must not be carried out. In unavoidable cases when carried out, a space maintainer must always be considered and inserted with the parent and child informed on the reason why such a decision is made.

In the child with a premature extraction, rather use a space maintainer for a short period, than having to go through the problem of functional and aesthetic sacrifice life long. I would emphasise the importance of maintaining deciduous teeth irrespective, if it is only going to be root stumps. When the choice by the practitioner is premature extraction, then he/she must at all times consider space maintainers. In my working environment, where correction of the developing malocclusion could be difficult due to the lack of expertise and when available, is expensive.
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1 INTRODUCTION

1.1 Definition of Problem

Dentistry in developed countries in the twentieth century has advanced to such heights that presently we are looking into many individual specialities for dental treatment. In the preventive field much attention is to fluorides, nutrition, habits with much emphasis on Dental Caries.

In the course of my work, I have many a time come across patients both male and female, between the ages of 10 to 16 years coming to seek advice on crowding of teeth affecting them both functionally and aesthetically, who in my view need orthodontic assistance. Coming from a developing country where orthodontic skills, being limited and more important, costly, puts these patients in a dilemma. In most of these patients the crowding is mainly caused by dental neglect in their childhood resulting as a last resort in premature loss of their deciduous teeth.

This thesis will review literature on space maintainers to find out if they could be used as a preventive measure in overcoming crowding caused by premature extraction of deciduous teeth.

The term Space Maintainer refers to an appliance designed to retain a given area or space, generally in the primary or mixed dentition. It may be functional or nonfunctional in varying degrees, depending upon the type of construction and need of the patient.
Function, as it relates to an individual's ability to masticate food, and as it relates to the physiologic harmony of the total masticatory apparatus, has been given little consideration for the child patient. How important and vital the proper and adequate mastication of food is to the health of the child or adult is not measurable at this time. However, it must be considered one strong link in the chain or sequence of the total digestive process. In all probability, some of the digestive problems associated with the various adult age levels have had their origin in the oral cavity of the child. The inability to masticate food, because of either the retention of infected deciduous teeth or the early loss of deciduous teeth, may have a profound effect upon the total physiologic and behavior pattern of the child.

1.2

Considering the growing prevalence of overcrowding of teeth affecting my patients both functionally, aesthetically and the lack of expertise and cost involved in treating such patients, has prompted me to look into preventive aspects in this field. This thesis aims to review literature on space maintainers and establish the definitive role of the appliance as a preventative measure in overcoming crowding of teeth.
2.1 Space Management Decisions and Parental Attitudes to Dental Health

Before each tooth is individually evaluated as to its suitability for pulp therapy, an overall assessment of the mouth must be made. The practitioner must ask himself why the child has so many untreated carious teeth, all of which may be suitable for pulp therapy. It may be that the parent has been unable to locate a dentist who is prepared to treat the child. Perhaps the child has been examined on various occasions by a visiting school dentist, but the parent has ignored the recommendation for dental care, finally being driven to seek an appointment by the child's pain. The latter parent, unlike the former will probably not be receptive to extensive appointments for pulp therapy and conservative dentistry.

The practitioner must attempt to evaluate each parent's attitude towards Dental Health. If it is negative, he should attempt to improve it by motivation and education. However, it may be fruitless to attempt extensive work because of parental apathy, manifested by poor appointment keeping and poor response to preventive recommendations. In these cases the treatment plan may have to be more radical and includes extraction.

Since the effects of space loss are most extreme prior to the completed eruption of the first permanent molar, every effort should be made to conserve the primary molars in a child under 7 years of
age. However, when a child presents with primary molars that are candidates for extraction, the effects of premature loss on the developing occlusion can be made only with adequate radiographs to permit observations of the developing succedaneous teeth. Well taken intraoral periapical radiographs will permit the most accurate evaluation of the teeth's suitability for pulp therapy, as well as the presence or absence of the developing permanent dentition, the dental age of the child, the possibility of ectopically erupting teeth, the eruption sequence and the presence of crowding. The alternative radiographic survey is extraoral in anxious patients and takes less time. However the practitioner must realise that the details of the pulp and periodontal tissues are of superior quality in intraoral films.

When extractions are unavoidable, compensating and balancing extractions of other primary molars must also be considered. Compensating extractions are those performed in the opposing arch but on the same side of the mouth. The objective is to obtain equal mesial movements of the first permanent molars on the side and good cuspal interdigitation of the permanent dentition. Balancing extractions are those performed within the same arch but on the opposite side. The object is to maintain symmetry in space loss within the affected arch. The location of other carious primary molars, the extent of tooth destruction and the teeth's suitability for pulp therapy must be taken into account when considering the use of compensating and balancing extractions. These extractions may also be indicated in children whose parents are negative towards dental health. It should be remembered though, that compensating and
balancing extractions do little to improve the parents attitude; rather, they are likely to become more convinced that primary teeth are not worthy of restorations.

The use of space maintainers should also be considered when primary molar extraction is necessary. They have the same ability to maintain symmetry in an arch as balancing extractions. While there will never be uniform agreement on the value of space maintainers, they do have a definitive place in paediatric dentistry. The problems they pose can be minimised by correct planning, construction and supervision of the appliance. Those who are experienced with their use tend to advocate them while those who are skilled in correcting the malocclusion that develops from early loss of primary molars tend to deprecate them. It is hoped that the final decision on their use is made with the best interest of the child at heart, and not the ability or whims of the dentist at heart.

2.2 Indications for Space Maintainers.

If lack of a space maintainer would lead to a malocclusion, or to the encouragement of detrimental habits or to psychic trauma, then a space maintainer is indicated. Placing maintainers routinely will do less harm than routinely not placing them.

a. When a second primary molar is lost before the second premolar is ready to take its place, use a space maintainer. A space maintainer need not be used if the second premolar is already erupting or gives every indication by roentgerography that it
will soon erupt.

The amount of space between the first molar and the first premolar may be greater than the roentgenographic width of the second premolar. This would allow a greater than usual late mesial shift of the first permanent molar and would still provide room for the second molar to erupt. In this event, the space should be measured and compared with the original measurement. If it is closing at a more rapid rate than the second premolar is erupting, insert a space maintainer.

b. The preceding method with measuring and waiting, may be enough to take care of early loss of the first primary molar. Statistics indicate that space closure following premature loss of the first primary molar is less in degree and frequency than that following premature loss of the second primary molar. Nevertheless, statistics applied to the total population, however comforting, should not lead to the neglect of a situation which can give trouble in an individual case.

c. In the case of congenitally missing second premolars it is probably better to let the permanent molars drift forward naturally and fill the space. It is better to make this decision later than early, since sometimes the second premolars are not bilaterally symmetric in the time of their development. Some do not show on the roentgenogram until 6 or 7 years of age.
d. Maxillary lateral incisors are very often congenitally missing. Almost always a mesially drifted cuspid can be dressed down to make a better looking lateral replacement than a fixed bridge in a space held open. Let the space close up.

e. Early loss of anterior primary teeth should be remedied by the placement of a space maintainer. Many sources indicate that the location of the developing permanent teeth prevents closure in the anterior part of the arch. This is not true in all cases. Not only may space close, with loss of arch continuity, but other factors enter the picture. The tongue will seek out spaces and thus habits may be encouraged. Defects in speech may be accentuated and prolonged. The absence of teeth in the front of the mouth before their loss in other children of the same age makes the child different and handicapped psychologically, if his temperament is vulnerable.

f. Many individuals are still in childhood when they lose one or more of their first permanent molars. This situation is deplored but in many sections of the country it is actuality. If the loss should occur several years before the eruption of the second permanent molar, the latter may move forward and erupt into normal occlusion, taking the place of the first permanent molar. If the second permanent molar is already erupted or partially erupted then there are two choices. Move the second molar forward orthodontically (by orthodontist) or hold the space open for a permanent bridge later on.
g. If the second primary molar is lost only a while before the eruption of the first permanent molar, a bulge on the crest of the alveolar ridge will indicate the site of the eruption of the first permanent molar, as shown in Fig 1. Roengerograms will help to determine the distance from the distal surface of the first primary molar to the mesial surface of the unerupted first permanent molar. A removable inactive functional space maintainer constructed to impinge on the gingival tissue just anterior to the mesial surface of the unerupted first permanent molar is particularly useful in a bilateral case of this kind, or even when the first primary molar is lost on the other side, as shown in Fig 2. Reinforcing the anchorage of the labial bow with selfcuring acrylic resin helps to keep the free saddle distal end in contact with the alveolar ridge.
FIGURE 1 AND 2  LOSS OF SECOND PRIMARY MOLAR JUST PRIOR TO ERUPTION OF FIRST PERMANENT MOLAR.

SOURCE: Sidney B. Finn (1967)
h. Most of the above situations in which space maintainers are indicated would make use of passive maintainers. There are situations in which an active maintainer can be used to advantage by the general practitioner. When the patient comes to the practitioner for the first time and it is found by manual examination and by roentgenography that there is not enough room for the lower second premolar but there is a space between the first premolar and the cuspid, the first premolar is slanting distally and is in end to end relationship with the maxillary first premolar - an active space maintainer is useful. It will open a space for the second premolar and restore the first premolar to normal occlusion.

2.3 Factors Governing the Use of Space Retainers

2.3.1 Tooth loss and time of loss

After a study of 100 children who had lost deciduous molars prematurely, Breakspear (1951) came to the following conclusion:

a. Some space is regained when the premolars erupt.

b. In a well developed child the amount of space lost after the extractions of single tooth is greater in the second year after the extraction than in the first year.

c. A poorly developed child may lose the critical amount of space in the first year.

d. The greatest amount of space lost occurs in the upper second deciduous molar region.

e. The total space loss to be expected in a given patient is related to the number of years which are likely to elapse
before the premolars begin to erupt rather than to any intrinsic age factor.

In the United States, Brauer found that 36% of spaces closed following the premature extraction of the first deciduous molars and 62% following the premature extraction of second deciduous molars. This was confirmed in Norway by Sunde who found that space closing occurred in the following order of frequency: upper second premolar region, lower second premolar region, upper first premolar region and lower first premolar region.

Since the anteroposterior location of erupting first permanent molars is largely determined by the second deciduous molars (Speidel 1952) a space maintainer should be made if the second deciduous molar is lost prior to the eruption of the first permanent molar. If however, the second deciduous molar is lost after the eruption of the first permanent molar, then other factors should be considered. For example, if the second permanent molar appears to be in advance of the second premolar in its time of eruption, (Radiograph) then a space maintainer should be considered. If however, the second premolar appears to be ahead of the second molar, the space should be measured and kept under observation at 2 monthly intervals. If the space is seen to be closing, then a retainer should be made.

Generally, if the deciduous molar is lost 3 years or more before the expected time of eruption of the permanent successor a retainer should be inserted. If the deciduous molar is extracted less than 3 years before the expected time of eruption of the permanent successor, a simple device such as a coiled spring retainer should be
inserted.

2.3.2 Number of teeth lost

When a number of deciduous teeth have to be extracted an attempt should be made to determine the probability of a malocclusion developing and if a space maintainer is necessary. If there is a reasonable chance that a normal occlusion will develop if the space is maintained, then a maintainer is indicated. On the other hand, if a malocclusion is going to develop regardless of the use of the space maintainer, then it has to be decided if a space maintainer will lessen the degree of malocclusion.

2.3.3 Other factors

A space maintainer should be inserted in a deciduous molar space when alveolar bone overlies the crown of an erupting premolar or when one third or less of the root of the permanent premolar is calcified.

In cases when the mandibular dental arch and the body of the mandible are in distal relationship to the maxillary arch a space retainer should be inserted following the premature extraction of a deciduous molar. A space maintainer should also be inserted in Angle Class III cases following premature extraction of a maxillary deciduous molar.

2.4 Planning for Space Maintenance

The following considerations are important to the dentist when he considers space maintenance after the untimely loss of primary teeth.

a. Time elapsed since loss
This factor should receive careful consideration. If space closure is to occur, it will usually take place during the first 6 month period after the extraction. In instances in which the dentist removes a primary tooth, if factors indicate a need for space maintenance, it is best to provide an appliance as soon as possible after the extraction. Watchful waiting for space closure after an extraction before planning space maintenance is not indicated.

In cases where children being seen much later (months or years), where changes in malocclusion have already taken place, it will be desirable to construct a space maintainer for no other reason than to aid in the reestablishment of normal occlusal function in the area. (Here it may also be desirable to construct a space maintaining appliance that will be active in regaining the lost space before holding it for the eruption of the permanent tooth).

b. Dental age of the patient

The chronological age is not so important as the developmental age. The average eruption dates must not influence decisions regarding the construction of space maintainers; there is too much variance in the eruption time of teeth. Studies by Gron showed that the majority of teeth erupt when 3/4 of the root is developed, regardless of the child's chronological age. However, one must bear in mind that the age at which the primary tooth was lost can influence the emergence time of the succedaneous tooth. A number of studies have indicated that the loss of a primary molar before 7 years of age will lead to delayed emergence of the succedaneous tooth, whereas the loss after 7 years of age leads to an early emergence.
c. Amount of bone covering the unerupted tooth

Emergence of the permanent tooth is accelerated if the bone covering the permanent tooth has been destroyed by infection. However, when bone loss has occurred before three fourths of the root of the permanent tooth has developed, it is best not to rely on the emergence being greatly accelerated. Instead, provide space maintenance and explain to the parent that the appliance might be needed for only a short time.

If there is bone covering the crowns, it can be readily predicted that eruption will not occur for many months; a space maintainer is indicated.

d. Sequence of the eruption of teeth

The dentist should observe the relationship of developing and erupting teeth to the teeth adjacent to the space created by the untimely loss of a tooth. For example, if a second primary molar has been lost prematurely and the second permanent molar is ahead of the second premolar in its eruption, there is a possibility that the permanent molar will exert a strong force on the first permanent molar, causing it to drift mesially and to occupy some of the space required by the second premolar. In such cases on analysis a space maintainer will be required.

e. Delayed eruption of the permanent tooth

Individual permanent teeth are often observed to be delayed in their development and consequently in their eruption. It is not uncommon to observe partially impacted permanent teeth or a deviation in the eruption path that will result in abnormally delayed eruption. In
cases of this type, it is generally necessary to extract the primary
tooth, construct a space maintainer, and allow the permanent tooth to
erupt and assume its normal position.

f. Congenital absence of the permanent tooth
In such cases the dentist must decide whether it is wise to attempt
to hold the space for many years until a fixed replacement can be
provided or whether it is better to allow the space to close.

g. Presentation of problems to parents
An important aspect of space maintenance is the presentation of
existing problems to the parents. Dentists should take sufficient
time to explain existing conditions and discuss the possibility of
the development of crowding if steps are not taken to maintain the
space or to guide the development of the occlusion. Emphasis here
must be made that a space maintaining appliance will not correct an
existing malocclusion but will only prevent an undesirable condition
from becoming worse or more complicated.

2.5 Requirements of a Space Maintainer
An important consideration in space maintenance is it should maintain
the full mesio distal diameter of the space. However, since the
space created by the premature extraction of a deciduous tooth, is
three dimensional, the retainer should also prevent overeruption of
teeth in the opposing arch. The appliance should be simple to
construct and it must not cause any injury to the abutment teeth or
soft tissues. It may be fixed or removable, depending upon the
length of time it is to be worn and upon economic considerations.
2.6 Practical Procedures

Before constructing a space maintainer, it is essential to decide if the space is likely to be lost. If it is, then will it be necessary to retain it, a full diagnosis and treatment plan are necessary for this decision.

2.6.1 Examination - general

Check -
- age of patient
- skeletal pattern
- occlusal class
- lip morphology and behaviour pattern
- tongue position
- associated habits
- tooth/tissue ratio

2.6.2 Local

Check -
- Condition and position of teeth adjacent to and opposing the space
- Presence and position of succeeding teeth in and near the space
- Position of space in the arch
- In which jaw the space is
- Length of time the space has existed
- Size of space in relation to the estimated size of the succeeding tooth
- Effects on function
- Effects on aesthetics
The assessment of all these factors will help to decide whether space is likely to be lost, and if it is, whether or not it is necessary to maintain it. Before deciding to maintain the space, consider:

Whether it is possible to do this without increasing the emotional load of the child or parents.

Whether the maintainer will increase the incidence of periodontal disease, or caries.

Whether there are any medical conditions which preclude the use of an intraoral appliance, fixed or removable.

If it is decided to maintain the space then decide what type of space maintainer will be indicated.
2.7 THE MANAGEMENT OF SPACE MAINTENANCE PROBLEMS

The damaging effects of the untimely loss of one or more teeth differ greatly in patients of the same age and stage of dentition. Conclusions drawn from observing small groups of children for a short period of time have resulted in many diverse and contradictory opinions concerning the indications for space maintenance after the loss of a primary tooth. However, if most patients with a premature loss of a primary tooth are observed in a critical manner, abnormal changes will be seen to take place than can be traced throughout the patients life.

Miyamoto and associates in their study of 255 school children 11 years of age found that children who had a premature loss of one or more canines or molars had a higher frequency of receiving orthodontic treatment of one type or another for the permanent dentition. The likelihood of need of treatment increased with the number of prematurely lost teeth. Children who had lost one or more deciduous teeth through age 9 had a greater than threefold increase in the frequency of orthodontic treatment relative to the control. There was a significant effect of the premature extraction of molars on malalignment, especially major malalignment of permanent teeth. Crowding of the anterior teeth was directly affected by the premature loss of deciduous canines.

The dentist who provides services for children is obliged to become proficient in dentition analysis in order to make predictions on a scientific basis regarding the need to maintain space. A tooth is maintained in its correct relationship in the dental arch as a result
of the action of a series of forces. Fig 3 attached. If one of these forces is altered or removed changes in the relationship of adjacent teeth will occur and will result in drifting of teeth, and the development of a space problem. Subsequent to these changes, inflammation and degenerative changes will occur in the supporting tissues.
FIGURE 3 FORCES THAT ACT ON A TOOTH TO MAINTAIN ITS RELATIONSHIP IN THE ARCH. IF ONE OF THESE FORCES WERE REMOVED, AS WOULD BE THE CASE IF A TOOTH MESIAL TO IT WERE EXTRACTED, FORWARD TIPPING AND MESIAL DRIFTING WOULD OCCUR.
Following is an example of forces that maintain the mandibular second primary molar in its correct relationship during the mixed dentition period. The first permanent molar exerts a mesial force on the second primary molar; the first primary molar exerts an equal and opposite distal force; the tongue on the lingual aspect and the cheek musculature on the buccal aspect also exert equal and opposite forces; the alveolar process and the periodontal tissue produce an upward force; and the teeth in the opposing arch exert a compensating downward force. An alteration in one of the forces, such as that which would occur if the first primary molar were extracted, would allow the second primary molar to drift forward under the influence of the first permanent molar. This force would be particularly strong if the first permanent molar were in an active state of eruption.

As a general rule when a primary molar is extracted or prematurely lost, the teeth both mesial and distal to it tend to drift or forced into the resulting space. Observations made indicate that the greatest amount of space closure may occur during the first 6 months after the untimely loss of a primary tooth. In many patients, however, a decrease in the space will be evident within a matter of days. Therefore it is unwise to subscribe to the theory of watchful waiting to determine whether the closure will occur because changes, particularly during certain stages of the development of the occlusion, occur within a matter of days or weeks.

Although there is lack of agreement regarding frequency with which space closure will occur or a malocclusion will develop after the untimely loss of a primary or a permanent tooth, a number of general
factors will influence the development of a malocclusion.

a. The abnormality of the oral musculature -
An abnormally high tongue position coupled with a strong
mentalis muscle may be damaging to the occlusion after the loss
of one of the mandibular primary molars. A collapse of the
lower dental arch and distal drifting of the anterior segment
will be the result.

b. The presence of oral habits -
Tongue or finger habits that provide abnormal forces on the
dental arch have also been shown to be responsible for
initiating a collapse after the untimely loss of teeth.

c. The existence of a malocclusion -
Arch length inadequacies and other forms of malocclusion,
particularly the Class II Division I variety, normally become
progressively more severe after the untimely loss of mandibular
primary teeth.

d. Stage of developing dentition -
In general more space loss is likely to occur if teeth are
actively erupting adjacent to the space left by the premature
loss of a primary tooth.
3 SPACE MAINTENANCE APPLIANCE

3.1 TYPES OF SPACE MAINTAINERS

Retainers may be of three main types: Fixed, semi fixed or removable.

a. Fixed retainers: Spring and ligature retainers, simple crown and bar, toverud retainer, steel crown and bar, orthodontic band and bar, simple crown and loop, pin and tube retainer, over extended amalgam filling or inlay or crown, and an activated space retainer.

b. Semi fixed retainer: Merston lingual arch

c. Removable retainers: Partial dentures and an Andresen pedodontic plate.

3.1.1 Spring and ligature retainer

This appliance has been used with conspicuous success in the Norwegian School Dental Services. In this type, the space is maintained by means of a coil spring made from 0.25 mm diameter hard stainless steel wire. The spring is made by coiling the wire round a thicker wire of diameter 0.7 - 0.9 mm. The retainer is constructed as follows:

Step 1: A length of coil spring is cut to the exact size of the space.

Step 2: Soft stainless steel ligature wire of diameter 0.25 mm is looped around the neck of the tooth distal to the space and tightened
by twisting the free ends in a clockwise direction.

Step 3: The free end of the ligature is threaded through the coil spring which is then adjusted to its correct position in the space.

Step 4: One free end of the ligature wire is passed around the lingual of the tooth, mesial to the space and passed through the interproximal space on the mesial of this tooth. The other end of the ligature is passed round the buccal of the same tooth and the two ends of the ligature are then twisted in a clockwise direction until the appliance is rigid.

Step 5: The twisted wire is cut leaving about 2 mm of twist which is pressed into the gingival crevice so that the ends of the wire are embedded in soft tissues. The construction of this appliance is illustrated in diagram attached (Fig 4).

Advantages - Can be made quickly. It is cheap. When properly adjusted it is rigid and it can be used to retain space created by the loss of one or more teeth.

Disadvantages - It will not prevent overeruption of an opposing tooth and it does not restore function to the affected quadrant.

It might be thought that the ligatures surrounding the abutment teeth would irritate the periodontal tissues. Clinical experience has shown that highly polished stainless steel wire is well tolerated by the soft tissues. Furthermore, experimental histological investigations by Waerhand have confirmed the clinical observations.
FIGURE 4  STEPS IN THE CONSTRUCTION OF A SPRING AND LIGATURE SPACE RETAINER
SOURCE:  Davis GN, King RH (1961)
3.1.2 Simple cap and bar

This appliance consists of a gold crown to which a platinised gold wire is soldered. The bar is soldered so that it extends from the contact point of the gold crown to the contact point of the tooth to the other end of the space. If properly aligned this appliance will prevent overeruption of a tooth in the opposing arch as well as preventing the mesial drifting of teeth posterior to the space.

Construction is as follows:

Step 1: An impression of the affected quadrant is taken in alginate or hydrocolloidal impression material.

Step 2: A model is poured in casting material.

Step 3: The model is trimmed to include the abutment teeth only. The gingival margin is trimmed to a depth of 1 mm round its entire circumference. This is done to ensure that the gingival margin of the completed crown will be situated in the gingival crevice when it is cemented in position in the mouth.

Step 4: Inlay wax is adapted to the investment model, carved to correct contour and attached to a sprue former.

Step 5: The wax pattern and the model are invested and the crown is cast in gold.

Step 6: The cast crown is placed in position in the mouth and an impression is taken from the tooth and placed in the impression. A model is poured in soldering investment and a 16 or 18 gauge platinised gold bar is soldered at the contact point.

Step 7: The completed appliance is polished and cemented in position in the mouth with crown and bridge cement, as shown in Fig 5.

Disadvantages include construction though simple is time consuming
and thus expensive. It is suitable only for maintaining the space created by the premature loss of a single deciduous molar. Its retention is often unsatisfactory. Alternatively, a modification known as the Toverud retainer may be constructed.

3.1.3 Toverud retainer

This is a simple modification of the crown and bar retainer. In this case the free end of the bar is fixed in a compound amalgam placed in the tooth at the end of a space remote from the crowned tooth.

3.1.4 Steel crown and bar

This consists of a preformed steel crown to which a stainless steel wire, bar or loop is soldered. Preformed steel crowns for each type of deciduous teeth are available in four sizes. A crown of the appropriate size is selected and contoured so that it is closely adapted to the abutment tooth.

An impression is taken with the crown in position, the crown is removed from the mouth and placed in the impression and a model in poured in soldering investment. A stainless steel bar or loop is then soldered to the crown in the same manner as for a gold crown or bar. In this case, however, low fusing silver solder and special flux are required.
FIGURE 5 CAST CAP AND SOLDERED BAR AND CAST CAP AND SOLDERED LOOP RETAINERS IN POSITION
SOURCE: Davis GN, King RM (1961)
3.1.5 Orthodontic band and bar

This retainer can fulfil similar functions to those of a crown and bar. It is, however, less rigid than the latter appliance and should only be used when a space is to be retained for a relatively short period of time. Essentially it consists of a band made of stainless steel or alloy material to which a bar is soldered. See Figure 6.

The main disadvantage of this appliance is that any force applied to the free end of the bar tends to stretch the band away from the abutment tooth. This may be overcome in some cases by soldering the bar at one end to the band and bending the free end vertically downwards through a wire loop soldered to a band on the tooth at the other end on the space.

3.1.6 Simple crown and intraalveolar bar

This appliance is used to retain the space created by the loss of a second deciduous molar prior to the eruption of a first permanent molar. The method of construction is as follows:

Step 1: Construct a gold crown for the first deciduous molar.

Step 2: Place the gold crown in the mouth and take a radiograph with the gap in place.

Step 3: Take a compound impression with the crown in position on the first deciduous molar.

Step 4: Remove the crown and place it in its correct position in the impression.

Step 5: Pour a model in soldering investment.

Step 6: On the radiograph, measure the distance from the distal of the cap to the mesial contact point of the unerupted permanent molar.
Step 7: Transfer this measurement to the soldering investment model.

Step 8: Cut a V-shaped groove across the ridge of the model so as to ensure that the vertical distal edge of the groove coincides with the measured distance from the crown.

Step 9: Cut a length of platinised gold wire (gauge 14-16) and adjust it so that it passes horizontally from just below the contact of the crown to the groove. Make an almost right angle bend in the wire at this point so that the vertical arm contacts the distal part of the groove and passes to the full depth of the groove.

Step 10: Solder the wire to the crown.

Step 11: Clean and polish the appliance and sharpen the tip of the vertical arm.

Step 12: Soak the appliance in Metaphen for 10-15 minutes and press firmly to place in the mouth.

Step 13: Take a second radiograph to check the relationship of the intraalveolar bar to the mesial of the unerupted first permanent molar. Adjust, if necessary by bending the vertical arm.

Step 14: Round off the tip of the vertical arm, repolish, soak in Metaphen for an additional 10 minutes and cement the appliance in position in the mouth.

When the first permanent molar has erupted into occlusion the vertical arm of the appliance may be cut off so that the appliance can continue to function as a simple crown and bar, as shown in the diagram attached (Fig 7)(Fig 8).
FIGURE 6  ORTHODONTIC BAND AND SOLDERED BAR SPACE RETAINER

SOURCE:  Davis CN, King RM (1961)
FIGURE 7 CAST CAP AND INTRAALVEOLAR BAR SPACE RETAINER

SOURCE: Davis GN, King RM (1961)
FIGURE 8  CAST CAP AND INTRAALVEOLAR BAR SPACE RETAINER
IN POSITION

SOURCE:  Davis GN, King RM (1961)
3.1.7 Simple Crown and loop

This appliance may be used where there has been unilateral loss of both deciduous molars after the eruption of the first permanent molar. It will prevent mesial drifting of the first permanent molar and the distal movement of the deciduous canine. However, it will not prevent overeruption of teeth in the opposing arch. See diagram attached.

A wire loop made of gauge 16 wire is soldered to the buccal and lingual grooves of a crown on the first permanent molar. The wire loop is adjusted so that it lies close to the buccal and lingual mucosa and passes forward to the contact point on the distal of the canine. In the mandible, care should be taken to ensure that the buccal wire does not extend too far down into the buccal sulcus.

3.1.8 Pin and tube appliance

This appliance may be used where there has been bilateral multiple loss of deciduous molars. It consists of gold caps on the deciduous canines with bars soldered on their distal aspects. To provide sufficient strength and to permit lateral growth of the anterior segment of the arch, the crowns on the canines are joined by means of a pin and tube. A length of buccal tubing is soldered to one crown and a wire to engage the tube is soldered to the other crown. See Figure 9.

3.1.9 Overextended amalgam filling or gold inlay

The space resulting from the premature loss of deciduous molars can be maintained by placing a filling, crown or inlay with an
FIGURE 9  PIN AND TUBE SPACE RETAINER IN POSITION

SOURCE:  David GN, King RM (1961)
overextended marginal ridge on a molar in the opposite jaw. For example if an upper first deciduous molar is extracted prematurely a mesio occlusal filling can be placed in the lower second deciduous molar. The mesial marginal ridge on the filling should be extended occlusally so that it prevents the upper second deciduous molar from drifting forward. If a lower second deciduous molar is extracted after the eruption of the first permanent molar a disto occlusal filling with an overextended distal marginal ridge can be placed in the upper second deciduous molar to prevent the lower first permanent molar from drifting forward (Sunde 1952).

3.1.10 Activated space regainer

This is a simple device for opening a second deciduous molar space which has partially closed. An orthodontic band is adapted to the first permanent molar. Horizontal tubes with an inside diameter of 0.036 in are soldered to the buccal and lingual surfaces of the band so that they are parallel to each other. A staple is made from 0.036 in round wire and the free ends are fitted into the tubes so that the staple shaped wire will slide freely against the first premolar. The two small metal stops are soldered to the anterior aspect of the staple wire and coil springs are threaded on the buccal and lingual arms. The length of the springs should be adjusted so that they are compressed when the appliance is cemented onto the first permanent molar. See Figure 10.

When sufficient room has been obtained from the second premolar to erupt, the springs should be removed and the staple wire soldered to the buccal and lingual tubes on the molar band. The appliance will then act in the same way as a band and loop.
FIGURE 10 ACTIVATED SPACE REGAINER IN POSITION

UPPER: RADIOPHGRAPh TAKEN IMMEDIATELY AFTER INSERTION

LOWER: RADIOPHGRAPh TAKEN 4 MONTHS AFTER INSERTION OF THE
APPLIANCE

SOURCE: Davis CN, King RM (1961)
3.1.11 Merston lingual arch

This appliance consists of an 18 gauge lingual arch wire attached to bands on the first permanent molar by means of vertical half round wires which are soldered to the arch wire and engage vertical half round tubes soldered to the molar bands. Gauge 20 spring wire is soldered to the free end of the arch wire and is bent back under the vertical tubes to act as locking devices. Spurs are soldered to the anterior section of the arch wire so that they contact the distal surfaces of the deciduous canines, as shown in Figure 11.

This appliance can be used in the upper or lower arch to maintain the space resulting from the premature loss of deciduous molars, after the eruption of the first permanent molars. It will prevent mesial drifting of the first permanent molars and the arch wire can also serve as a base for the attachment of springs for minor orthodontic movement.

3.1.12 Removable partial dentures

The simplest alternative to a fixed or semifixed retainer is an acrylic partial denture with a wire incorporated in the acrylic in the lingual aspect. Artificial teeth may be attached to the acrylic. Alternatively the acrylic base can be built up to the level of the occlusion in the space created by the extraction of the deciduous molars. See Figure 12. If the first permanent molars have
FIGURE 11  MERSTON LINGUAL ARCH SPACE RETAINER

SOURCE:  Davis GN, King RM (1961)

FIGURE 12  REMOVAL PARTIAL DENTURE SPACE RETAINER

FABRICATED IN CLEAR ACRYLIC RESIN TO SHOW

POSITION OF LINGUAL WIRE

SOURCE:  Davis GN, King RM (1961)
erupted, retention may be enhanced by incorporating Adams clasps in the acrylic to engage the first permanent molars.

This appliance will prevent the mesial drifting of the first permanent molars and will prevent overeruption of the molar teeth in the opposing arch. If worn at meal times, it will increase the child's masticatory efficiency.

3.1.13 Andresens pedodontic plate
Sunde recommends this appliance for use when there has been premature loss of deciduous molars in both the mandible and the maxilla. The acrylic base fills both mandibular and maxillary spaces and has a maxillary labial arch wire attached. The appliance is worn mainly during the night. It will prevent mesial drifting of first permanent molars and overeruption of unopposed teeth but because it extends into both mandibular and maxillary spaces it cannot be worn at meal times.

3.2 Selection of the Type of Appliance
There are two categories of appliances, fixed and removable. Decide for each child the type of maintainer to be constructed, taking into consideration the length of time the appliance is to be worn and the following factors.

3.2.1 Fixed
Advantages:
1. Does not need patients cooperation
2. Can restore carious teeth adjacent to the space with the same appliance
3. Does not allow tilting of adjacent teeth
4. Can be used for intermaxillary retention

Disadvantages:

1. Requires more surgery time
2. May cause discomfort if it breaks
3. May be dislodged by stick foods

3.2.2 Removable

Advantages:
1. Can replace many teeth on both sides of the arch
2. Requires little surgery time
3. Can be adapted as a prosthetic device
4. Needs no preparation of adjacent teeth

Disadvantages:
1. Needs full patient cooperation
2. Potentially harmful to adjacent teeth and soft tissues
3. If not adequately cleaned, will hold food debris against teeth and gums
4 SIGNIFICANCE OF PREMATURE LOSS OF DECIDUOUS TEETH

4.1 A Report of 113 Early or Premature Extractions of Primary Molars and the Incidence of Closure of Space

The early or premature extraction of primary molars has caused much concern within the past two years, and there are those in the profession who do not make a serious attempt to evaluate such extractions in terms of the future. In too many instances primary molars are removed without discussing with the parent the probability of closure of space and the probable orthodontic implications. Parents have frequently made this comment: "why didn't my dentist discuss the possibility of closure of space?" This latter question may be answered in part by the instruction the student received while in dental school. Often little or no actual experience has been obtained because of lack of requirements in the teaching of dentistry for children, and the end result is only a passing interest.

Various estimates from 20 to 65 per cent have been made stating that early or premature extraction of the primary teeth was the cause of malocclusion. Cohen in his study of 21 patients wherein 15 second primary molars were removed, and found that 9 out of 15 second bicuspids erupted in good position. Therefore, 42% of the space closed when the second primary molar was removed prematurely.

The writer has observed 41 children who have come to the dental clinic at the University of IOWA Childrens Hospital for an average period of 24.6 months, and the time range was from 4 to 64 months. Each patient had a complete dental examination at least every 6 months, and in most instances roentgenograms were taken every 6
months. The patients were mainly controlled diabetics and congenital syphilisics who returned to the outpatient clinic for routine check ups. It is the policy of the Paediatric and Pedodontic staffs to have roentgenograms of the arches and teeth made every 6 months which enables one to make regular observations of a group of patients over a long period of time.

The following data is herewith presented:

a. Premature extractions of 42 first primary molars:
22 or 52% of the first bicuspid erupted in fair position. 5 or 12% of the spaces were not closed and the bicuspid still had an opportunity to erupt (Observed 1 for 6 months, 3 for 27 months and 1 for 29 months). 1 bicuspid erupted in a definite malocclusion and 14 or 36% with space closure and definite malocclusion.

b. Premature extraction of 71 second primary molars
24 or 34% of the second bicuspid erupted in fair positions. 3 or 4% of the spaces were not closed and the bicuspid still had opportunity to erupt. (Observed 1 for 6 months, 1 for 27 months and 1 for 29 months). 2 second bicuspid erupted in definite malocclusion. 42 or 62% with closed spaces and definite malocclusion.

It was of further interest to note that in 17 patients, 26 first and second primary molars were removed at the same time in the same segment. Following information is from this group:

i) 9 or 35% had the first and second bicuspid erupt in fair position

ii) 2 or 8% has spaces remain open giving both bicuspid an opportunity to erupt
iii) 11 or 42% had the first bicuspids in good position with the second bicuspid space closed with malocclusion

iv) 4 or 15% presented both bicuspids in malocclusion

From the observations cited in this study, our findings disclosed that in the children we studied with premature loss of the first deciduous molar did not result in collapse of space, so space maintainers as such, are seldom indicated, in these cases. The loss of the second deciduous molars presents a different picture. The space created by its loss should be carefully observed and a maintainer placed in the arch at the first indication that space is materially closing. But here again, if the second deciduous molar is lost before the first permanent molar erupts, the problem is accompanied with serious difficulties.

On the conclusion of the studies, the summary of findings include:

I  Approximately one third of the first primary molars removed early or prematurely will lead to closure of space and malocclusion.

II  At least one out of every two of the second primary molars removed early or prematurely will result in closure of space and malocclusion.

III  Approximately four out of five bicuspids will erupt in fair position when both the first and second primary molars are extracted prematurely at the same time in the same segment. However, approximately one half of the second bicuspid will not be able to assume their intended position.

IV  The practitioner thinking only in terms of closure of space (first and second primary molar area) and not in terms of function and extrusion of the opposite tooth may resort to a period of
observation to note the tendency to collapse.

V In cases where the arch form and occlusal relationship is acceptable and one anticipates at least three months or more time before the bicuspids will erupt, and wherein there is some concern about the possible extrusion of the opposite tooth or teeth and function in the area, the author advises a space maintainer in either the first or second primary molar area.

4.2 The significance of early loss of deciduous teeth in the etiology of malocclusion

The relative significance of genetic and nongenetic factors in crowding and spacing, according to investigations the author has performed on 202 pairs of twins is shown in Fig 13. Genetic and nongenetic factors seem to have about the same influence, perhaps with some preponderance for the former. Clearly, it is no simple matter to decide, in the individual case, whether crowding that appears after premature loss of deciduous teeth is due to this loss or whether a coincident hereditary influence is, in fact, responsible. Even if the crowding is localised to the second premolars, it cannot be excluded that as such, it is genetically determined and that only its localisation and degree are ascribable to the premature loss.

One difficulty is deciding the effect of early loss of deciduous teeth relates to the fact that tooth migration after such loss may be of a temporary nature. Rather extreme cases of this type have been published by Kantorowicz and Seipel. Systemic investigations of the relationship between premature loss and subsequent crowding of the
teeth have been made by several workers, for some of which the size of the case series and the age at the final observation are given in the table following:
<table>
<thead>
<tr>
<th>Author</th>
<th>No. of cases</th>
<th>Age at final observation years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ungar</td>
<td>292</td>
<td>7 to 9</td>
</tr>
<tr>
<td>Schachter</td>
<td>130</td>
<td>11 to 16</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>10 to 16</td>
</tr>
<tr>
<td>Lundstrom</td>
<td>118</td>
<td>12 to 14</td>
</tr>
<tr>
<td>Seipel</td>
<td>50</td>
<td>10 to 14</td>
</tr>
<tr>
<td>Breakspear</td>
<td>100</td>
<td>9 to 11</td>
</tr>
</tbody>
</table>

Although the investigations of the influence of premature loss were not satisfactory in all respects, it probably is worth while to review them, especially the last three listed.

In a statistical study of tooth spacing in each quadrant of the mouth, comparisons were made between cases with and cases without early loss of deciduous molars. Account was taken of the degree of crowding or spacing. A distinction was made between loss at 7 or 8 years of age and loss at 9 or 10 years of age, and between cases with a loss of the first or the second or both first and second deciduous molars. The degree of crowding or spacing was measured in six sections, around the dental arch, between the first molars on each side as shown in Fig 14. Crowding or spacing (CS) were expressed as a percentage:
Jaw halves with first permanent molars extracted were not included. If permanent lateral incisors, canines or premolars were missing, the CS value was calculated on the full complement of teeth, the missing values being obtained from the corresponding tooth on the opposite side; where the tooth was absent from the ratio between adjacent teeth. Omission of such cases was impractical, since most of them had teeth extracted because of crowding.

The frequency of extracted deciduous molars is given in the histogram (Fig 15). Figs 16, 17, 18, 19 and 20 shows the relationship between such extractions and the degree of crowding in different sections of the arches and for the whole dental arch. In Fig 16, 17 and 18 the unit employed in the classification of crowding is 10 per cent, percentages above - 2.5 being counted as 0, those from - 2.5 to - 12.5 as - 1, those with - 12.5 to - 22.5 as - 2 and so on. The value - 4 represents a degree of crowding roughly equivalent to the complete blocking out of one second premolar. For Figs 19 and 20, the unit of crowding is 4 per cent and the limit between 0 and - 1 is given at - 1 per cent. In this instance, the value - 4
FIGURE 13  HISTOGRAM, SHOWING SIGNIFICANCE OF NONGENETIC AND GENETIC FACTORS TO THE SPACE DIFFERENCE

SOURCE: Lundstrom (1976)

![Histogram showing non-genetic and genetic variation in upper and lower jaws.](image-url)
FIGURE 14  DEGREE OF CROWDING OR SPACING IS MEASURED AS A DIFFERENCE BETWEEN THE PERIMETER OF THE DENTAL ARCH AND THE SUM OF INDIVIDUAL TOOTH BREADTHS. THE PERIMETER IS OBTAINED BY MEASURING THE ARCH IN SIX SECTIONS FROM M1 ON ONE SIDE TO M1 ON THE OTHER SIDE.

SOURCE: Lundstrom (1976)
corresponds, roughly, to the blocking out of two premolars, one on each side.

The results suggest that it is particularly the earlier extractions that contribute to the development of crowding.
FIGURE 15  DISTRIBUTION OF EARLY LOSS OF DECIDUOUS MOLARS
IN THE STUDY GROUP
SOURCE:  Lundstrom (1976)

LEFT UPPER

No loss

d
e
d + e

RIGHT UPPER

No loss

d
e
d + e

LEFT LOWER

No loss

d
e
d + e

RIGHT LOWER

No loss

d
e
d + e

- No early loss of deciduous molars
- Loss of d or e or d + e at 7 or 8 years
- Loss of d or e or d + e at 9 years for d, at 9 or 10 years for e
- Loss of d + e (d at 9 and e at 7 or 8 years)
- Loss of both d and e (d at 7 or 8 years and e at 9 or 10 years)
FIGURE 16  CROWDING OF UPPER SECOND PREMOLAR
SOURCE:  Lundstrom (1976)

CROWDING OF UPPER SECOND PREMOLAR
  □ WITHOUT LOSS 7-10 YEARS
  □ WITH LOSS AT 9 OR 10 YEARS
  □ WITH LOSS AT 7 OR 8 YEARS

FIGURE 17  CROWDING OF LOWER SECOND PREMOLAR
SOURCE:  Lundstrom (1976)

CROWDING OF LOWER SECOND PREMOLAR
  □ WITHOUT LOSS 7-10 YEARS
  □ WITH LOSS AT 9 OR 10 YEARS
  □ WITH LOSS AT 7 OR 8 YEARS
FIGURE 18  CROWDING OF CANINES OR SECOND PREMOLARS

SOURCE:  Lundstrom (1976)

CROWDING OF CANINES OR SECOND PREMOLARS

FIGURE 19  CROWDING OF THE UPPER JAW M1 - M1

SOURCE:  Lundstrom (1976)
FIGURE 20 CROWDING OF THE LOWER JAW (M1 - M1)

SOURCE: Lundstrom (1976)
It is evident also that, even in such, it is not infrequent that normal spacing conditions eventually may be obtained. The reduction in normal spacing for the whole dental arch after extractions at 7 or 8 years of age appears to be about 22 per cent in the upper arch and 13 per cent in the lower. On a general analysis the loss of space seems to be moderate in a great many cases. In some, however, we get a manifest and possibly a permanent effect.

One other circumstance that contributes to the variations in migration is the intercuspitation. The relative arch spacing is the most important cause of differences in reaction to premature extraction. If there is a tendency to fairly large jaws, with normal spacing of the teeth or perhaps a slight overspacing, it is possible that extraction will have no influence at all. On the other hand, if there is a tendency to crowding and there is a certain amount of contact pressure between the teeth, an extraction probably can quite often produce a permanent closing of space, even in the total perimeter of the dental arch.

4.3 Effect of premature loss of deciduous canines and molars on malocclusion of the permanent dentition

There was a significantly increased frequency of orthodontic treatment among those with the premature loss of one or more deciduous teeth. Of those with no history of orthodontic treatment, there was a significant effect of the premature loss of molars but not canines on malalignment. Anterior crowding was related only to the premature extraction of canines.
It is generally accepted that the premature loss of deciduous teeth is associated with the malocclusion of permanent teeth. However the basis of such a relationship has often been challenged. In an epidemiologic study in Denmark, it was found that about 45% of the children with the premature loss of deciduous canines and molars had permanent teeth extracted for orthodontic reasons. Children with a premature loss of primary teeth had more than three times the frequency of orthodontic treatment than those who had not lost their deciduous teeth prematurely. The premature loss of any primary molar was observed to cause the reduction of space for the permanent teeth.

In reviewing the literature on space closure after the extraction of deciduous teeth, Owen pointed out that there are many contrasting opinions. The special role of the loss of the primary molars has been studied more intensively. Drift of the permanent teeth is known to be associated with the time of loss of the primary molars in relation to the eruption time of the permanent first molar. Furthermore, the timing of eruption of premolars is known to be influenced by how early the deciduous molars are lost. Specific factors reported to be related to tooth migration are age, leeway and cusp height.

The question has been raised as to whether the space closure associated with the premature extraction of deciduous teeth has significant consequences on the permanent dentition. The purpose of the present investigation is to determine the effects of the premature loss of the deciduous canines and first and second molars on malalignment and crowding in permanent teeth.
The special features of the study are a relatively large sample size, 255 children; and older age of children (11 years or older) at the time of evaluation of malocclusion.

The final results show that children with premature loss of one or more canines or molars have a greater likelihood of receiving subsequent orthodontic treatment on the permanent teeth. For example, 17.0% of those children with the premature loss of one or more deciduous teeth through age 9 had undergone orthodontic treatment of one type or another in comparison with 4.7% for those without any premature loss, an increase of 3.6 times. The study also saw no effects of the premature loss of canines on malalignment, but has shown a clear adverse effect on the crowding of the anterior teeth. This could probably be to the mesial drift of the posterior teeth after the premature loss was sufficiently strong to cause crowding of the anterior teeth but not strong enough to lead to pronounced malalignment of these teeth. The results of this study agrees with other studies in that the earlier in time deciduous molars were lost, the more malalignment occurred in permanent teeth.

On the conclusion, children who had a premature loss of one or more canines had a higher frequency of receiving orthodontic treatment, of one type of another for the permanent dentition. The likelihood of need of treatment increased with the number of prematurely lost teeth. Children who had lost one or more deciduous teeth through age 9 had a greater than threefold increase in the frequency of orthodontic treatment relative to the control. Of those who did not receive orthodontic treatment, there was no detectable relationship
of the premature loss of canines with the malalignment of permanent teeth. However, there was a significant effect of the premature extraction of molars on malalignment especially major malalignment of permanent teeth. No differences were noted in their effects between the first and second deciduous molars. Crowding of the anterior teeth was directly affected by the premature loss of deciduous canines.

4.4 Incidence and effects of premature loss of deciduous teeth

Premature loss of deciduous teeth has always played an important part in discussion on the cause of malocclusion is evidence by a perusal of recent literature on orthodontics and preventive dentistry. Baker, Chapman and Humphrey claim that of all the possible etiologic factors, this is by far the most prevalent.

In this study, the data is based on findings in 1185 sets of dentures, representing 292 children ranging in age from three to fourteen years inclusive. The children being mainly from middle class families whose diet and health were similar to those of average children of a similar social sphere with each child examined at yearly intervals and in each case at least two sets of dentures were taken. The aim of this study is to look into:

1. whether the spaces resulting from premature loss of deciduous teeth close, open or remain unaffected, and

2. the effect of premature loss on the subsequent eruption of the permanent teeth

Conclusive results on the above studies were:

1. There is no difference between males and females as regards
premature loss

2. Abnormal occlusion cases definitely show a higher percentage of premature loss than do cases of normal occlusion

3. With premature loss the spaces close in a large percentage of cases

4. Premature loss occurs more frequently in the mandible than in the maxilla

5. More teeth are lost prematurely on the right side than on the left, but the difference is not marked

6. Teeth in the mandible drift far less than those in the maxilla

7. With premature loss the type of occlusion plays no part whatsoever as to whether the permanent teeth will erupt normally

8. In all cases in which space maintainers were used the permanent teeth erupted normally

9. In all cases of premature loss of deciduous canines there was normal eruption of the permanent canines

10. The loss of the second deciduous molar causes the highest percentage of impactions and crowdings of its permanent tooth, and the first deciduous molar comes next in this regard

11. There are more abnormal eruptions in the maxilla than in the mandible

Molar Migration

As each molar erupts against the distal crown surface of the deciduous second molar, there is a normal vertical alignment of permanent root and crown to establish a slight mesial inclination of the molar. Each permanent molar will erupt too far mesially, if the
second deciduous molar is absent. If this is not prevented, the lower molar will erupt in a straight line path, giving the appearance that it has tipped to the mesial. By contrast, the upper permanent molar swings to the mesial and because the roots are more mesialward to begin with, it gives the impression that there has been more bodily displacement of this tooth. If the upper second deciduous molar is lost prior to the eruption of the upper permanent first molar and the permanent molar is allowed to erupt without guidance, it will frequently migrate far enough mesially to completely occupy the deciduous second molar space.

4.5 Promoting normal development by maintaining the function of the deciduous teeth

In order to have normal development, all forces affecting such development must be working in harmony. Nature's struggle is to reach maturity without a handicap, and it is our duty to remove all interferences as nearly as we can. Nature's plan in the development of these are:

1. There must be a sufficient amount of space between the deciduous cuspids to accommodate the permanent central and lateral incisors.
2. The amount of space occupied by the deciduous cuspids and molars is nature's provision for the bicuspids and permanent cuspids, augmented by additional growth possibly, but under no condition to be infringed on by other teeth.

Our task is then to aid nature by maintaining this equilibrium above all things, and possibly the best way to sound a warning against neglect in this respect is to present a few cases that show the
result of indifferences in this matter. In one of the first cases to present itself to us in the daily routine of practice, the permanent lateral incisors are erupting in the lower jaw, and are lingually to the normal, with insufficient space between the permanent central incisors and the deciduous cuspids. Frequently in such instances the deciduous cuspids is removed to make room for the lateral incisor. This temporary measure relieves the situation. When the permanent cuspids tries to assume its allotted place in the arch, that space is already occupied in whole or part, by the lateral incisor. The good intent in extracting the deciduous cuspids has resulted in causing a malocclusion. In cases where extraction was not done, natural adjustment would have taken place.

In order to promote normal growth and development of the face, every tooth should retain its full span of time, but no longer, and during that period should have the advantage of its full anatomic form. The amount of disturbance in the development of the arch is directly proportionate to the amount of tooth structure destroyed, reaching its heights with the complete loss of its tooth.

If for any reason a tooth must be lost prematurely, we should take every precaution to prevent any disturbance of the forces of normal development. Space maintainers should be placed to prevent shifting of the other teeth.
FIGURE 21. FREQUENCY OF OCCURRENCE OF VARIOUS ETIOLOGIC FACTORS IN DENTOFACIAL DEFORMITIES

SOURCE: Brauer (1941)

Frequency of Occurrence of Various Etiologic Factors in Dento-Facial Deformities

Controllable

Premature Loss of Deciduous Teeth -- 20%

37% Permanent Teeth -- 5%

Prolonged Retention of With Habits -- 12%

Deciduous Teeth 19%

Purely -- 16%

Associated with Habits -- 3%

Mouth Breathing

Thumb or Finger Sucking

Tongue Sucking

Sleeping Habits

Lip Biting

Posture Habits

Questionable

Habits (not Included Above) 25%

Congenital (Recognized) 5%

Other Factors 19%

Not Classified 14%
The table shown in Fig 21 is significant. When we realise our responsibility in this matter, there is reason to shudder. About three fourths of the abnormalities we see could have been averted if we had done what the public had a right to expect of us. As a profession, we must assume our full responsibility in prevention as well as in treatment. Promoting normal development by maintaining the function of the deciduous arch is the first step towards meeting the responsibility.

4.6 The deciduous molars - Nature's space retainers

Dr Cecil in a symposium held before the New York Academy of Dentistry as cited by Curley (1931) spoke as follows:

In respect to pediatrics, we are concerned chiefly with preventive dentistry. Perhaps the most important phase of this problem is the determination of adequate vitamin supply in the child's diet. Next in importance I would place orthodontia. The orthodontist has come to play an active part in the lives of children with "crooked" teeth. Whether these irregularities are hereditary, nutritional or mechanical, they must be corrected as far as possible, not only for esthetic reasons, but also for the better preservation of the teeth themselves.

I come before you with a plea for the retention of the deciduous molars until the proper time for replacement shall have come, and with the suggestion that proper consideration of these teeth as space retainers will carry is far into the field of "Preventive Orthodontia".
The author wishes to confine our attention to the deciduous molars and their successors, the bicuspids exclusively. You will note that the bicuspids measure 7.2 and 6.8 mm, respectively, in the upper jaw and 6.9 mm and 7.1 mm in the lower. The deciduous molars measure, respectively 7.7 and 9.2 mm in the lower jaw. The deciduous molars are considerably wider mesiodistally than the bicuspids. This fact is of great importance. Nature made it so and it is not ours to alter, nor allowed to be altered. If one or more of these be lost, a guiding influence is gone and irregularity ensures. I hope to persuade you as to the necessity of retaining the deciduous molars until the time for shedding has arrived; that abscesses may be successfully treated and the canals filled; that root absorption progresses about normally, and that the deciduous molars may be successfully handled from the standpoint of dental treatment.

4.7 The Effects of Premature Loss of Primary Teeth and Sequence of Eruption of Permanent Teeth on Malocclusion

In a study conducted at the New York University College of Dentistry, four hundred children were examined and treated, during a period of fourteen years. All the children were entered in the clinical study before age four. The complete examination of these patients included, among other items, full mouth radiographic series at least every six months and study cast at least annually throughout the periods of the primary dentition, the mixed dentition, and the early years of the complete permanent dentition. The aim of the study also included the study of the incidence of premature loss of primary teeth, apparent effects on the incidence of malocclusion and effect of the use of space maintainers on the incidence of malocclusion.
Here premature loss was defined as a primary tooth, when it was missing at least six months prior to the loss of homologous teeth in the same mouth.

The outcome of the study on this aspect includes, when a primary molar was lost prematurely, and the space not maintained, a permanent canine or bicuspid was usually found to be malposed.

The records of this study show 131 prematurely lost primary canines and molars. Analysis of this figure, tooth by tooth, shows the following:

1. 11 primary canines: none of them replaced by space maintainers
2. 68 first primary molars: 18 of them were replaced by space maintainers
3. 52 second primary molars: 23 of them were replaced by space maintainers

Of the 11 primary canines lost prematurely, 9 (81.81%) were followed by a loss of space, and a consequent malposition of a permanent tooth in that quadrant. 2 (18.19%) were not followed by a loss of space.

6 of the prematurely lost primary canines occurred in the lower jaw. In each instance (100%) there was a loss of space followed by malposition of one or more teeth in that quadrant.

Of the 68 first primary molars lost prematurely, 30 (44.11%) were followed by a loss of space and a consequent malposition of a permanent tooth, in that quadrant. 38 (55.88%) were not followed by
a loss of space, and consequent malposition. Of these 38 cases, 12 had been successfully maintained by an appliance. Presumably 44% of the cases maintained by an appliance would otherwise have been followed by a loss of space and malposition.

We must conclude, therefore, that in slightly more than 50% of the cases a malocclusion will follow the premature loss of a first primary molar. Of the 52 second primary molars lost prematurely, 29 (55.76%) were followed by a loss of space and a consequent malposition in that quadrant.

23 (44.24%) were not followed by a loss of space and consequent malposition. Of these 23 cases, 14 had been replaced by appliances. Presumably, 56% of the cases maintained by an appliance would otherwise have been followed by a malposition. We conclude, therefore, that 70% of all second primary molars that are prematurely lost would result in a loss of space, since again eliminating the cases in which a space maintainer was used, we find that of the 29 cases where a second primary molar was lost prematurely, there was a loss of space in (69%) 20 cases.

We have thus found that there is a need for space maintenance in 70% of prematurely lost second primary molars, 51% of prematurely lost first primary molars, and 81% of prematurely lost primary canines.

There were fifteen cases where a space maintainer was used, but failed to prevent the loss of space. The reasons for failure were as follows:
1. Too great a lapse of time between the loss of the primary tooth and placement of the appliance i.e. too much "watching and waiting" to see if something was needed.

2. Loss of the appliance due to the loss of an abutment tooth long before the permanent successor could be expected to erupt.

3. Poorly constructed space maintainers, bending of the bar due to the forces of mastication.

Thus in the final summary all prematurely lost primary canines and molars should be replaced by space maintainers immediately, whenever possible, without any period of watching and waiting to see what happens, since very early premature loss of a primary tooth results eventually in delayed eruption of the succedaneous tooth, probably in malposition, unless a space maintainer is used.
5 DISCUSSION

The anatomy of man, though science has advanced to the nuclear age, has not changed. The skull looking at it completely and tooth morphologically is and will be the same, irrespectively of time and what theory believed on the existence of mankind.

The ultimate outcome of the writer's review of literature may vary from developed to developing countries, but bearing in mind and hoping to use the outcome of my study in a developing country, it will be more beneficial to look into space maintainers, for children either naturally or by appliance, to prevent malocclusion either completely or almost completely considering the lack of expertise and cost involved in treating them later.

Dentistry has generally progressed to great heights in developed countries, that much emphasis has been placed on conservation. In my country though conservation is being emphasised but in a majority of cases, due to both parent and child lack of dental consciousness, there is always a preference for extraction than conservation by filling, leaving aside root canal treatment.

When such is the outlook of a majority of the population, there is invariably a very good chance of the poor child developing crowding in a small way affecting them both functionally and aesthetically. In view of the above due consideration must be given to space maintainers either simple or complex.

Having reviewed literature into the various aspects of space
maintenance, the appliance and the various studies done or premature loss of deciduous teeth, certain guidelines must be used to evaluate the use of the appliance. Much emphasis must always be given for the conservation of the tooth than extraction. For this an overall assessment of the mouth must be done and a treatment plan drawn up. As far as possible extraction must be done as a last resort. The parent and child must be cautioned on the possible problems in the event of an extraction depending on the tooth involved. Fillings and root canal treatment must always be emphasised and in cases where there is a negative response, no treatment will be required and just leaving the tooth in place until its ultimate exfoliation will be the other option. In cases of infection, antibiotic therapy will be useful. By maintaining the deciduous teeth in place, it will act as Nature's space maintainers, and proper explanation must be given to the parent on the reason why this is being done.

In cases where extraction is inevitable, then depending on the time of extraction, the use of space maintainers must always be considered. The order of priority will be 2nd deciduous molar, deciduous canine, 1st deciduous molar and the incisors. As a general rule, depending on the time of extraction and the position of the succeeding permanent tooth, will be decisive on the placement of a space maintainer. Placing maintainers routinely will do less harm than routinely not placing them. When a second primary molar is lost before the second premolar is ready to take its place, use a space maintainer.

A space maintainer need not be used if the second premolar is already
erupting or gives every indication by roentgenography that it will soon erupt. In the case of a congenitally missing second premolar, it is better to let the permanent molars drift forward naturally and fill the space. Very early loss of anterior primary teeth should be remedied by the placement of a space maintainer. Other important factors to be considered are tooth lost and the maxillary-mandibular relationship. If a deciduous tooth is lost 3 years before the expected time of eruption of the permanent successor, a retainer should be inserted. If the deciduous molar is extracted less than 3 years before the expected time of eruption of the permanent successor a simple device such as a coiled spring retainer or acrylic plate should be considered.

When a number of deciduous teeth have to be extracted, an attempt should be made to determine the probability of a malocclusion developing and if a space maintainer is necessary.

If a malocclusion is going to develop regardless of the use of a space maintainer, then it has to be decided if a space maintainer will lessen the degree of malocclusion.

A space maintainer should be strongly considered in a deciduous molar space when alveolar bone overlies the crown of an erupting premolar or when one third or less of the root of the permanent premolar is calcified. In cases when the mandibular dental arch and the body of the mandible are in distal relationship to the maxillary arch a space maintainer should be inserted following the premature extraction of a mandibular deciduous molar. A space maintainer should also be
inserted in Angle Class III cases following premature extraction of a maxillary deciduous molar.

On the selection of the type of space maintainer to be used, generally speaking, most space maintenance can be accomplished by inserting removable, passive space retainers made of wire and acrylic resin. The use of self-curing acrylic makes this an easy, fast procedure. Bands are involved in the use of some space maintainers. A well-fitting tailor-made band constructed in the patient's mouth is usually more satisfying than one made on a stone model by a laboratory. Preformed bands available in different sizes can be used advantageously. The most important consideration irrespective of appliance type in space maintenance is for the maintenance of the full mesial distal diameter of the space. The retainer should also prevent overeruption of teeth in the opposing arch. The appliance should be easy to construct and it must not cause any injury to the abutment teeth or soft tissues. It may be fixed or removable depending upon the length of time it is to be worn and upon economic considerations. On the type of appliance to be used it will vary and is entirely up to the practitioner himself/herself considering amongst the above discussed points his working environment and patients attitudes.
6 CONCLUSION

Crowding of teeth, judging from the various studies has got to be accepted that it is more often than not dentist created than a natural sequence. If this is looked into with depth through caution exerted by dentist and better education of both parent and child, deciduous teeth will be nature's best space maintainers, that is to say, doing the utmost treatment needed for the deciduous teeth and preserving them there until ultimate exfoliation. As a profession we must assume our full responsibility in prevention as well as in treatment. Promoting normal development by maintaining the function of the deciduous arch is the first step towards meeting this responsibility.

Judging from the review of studies on the effect of premature loss of deciduous teeth, it is an accepted fact that space lost is caused by premature loss of deciduous teeth. Certain explanations indicate that space lost will be regained with the growth and development of the maxilla and mandible and nature's adjustment, but in a majority of cases the space lost is significant enough to create this crowding. It is more marked with premature loss of 2nd deciduous molars, deciduous canines and 1st deciduous molars or a combination of the above. The controversial point which could be raised is the sample size of the studies done, but judging from the common outcome that premature loss of deciduous teeth is the major cause of crowding should silence critics.

Bearing in mind my study, and hoping to use the outcome of my literature review in a developing country where it is sad to say that
the attitudes of the practitioners, trying to make an easy way out and parent ignorance, there is inevitably a premature loss of deciduous teeth. When such is the case, the poor child, not knowing the consequences of the aesthetic and functional setbacks will have to live with the developing malocclusion. When such is the case, the next resort will be towards correction of the crowding problem and with orthodontist help being scarce, and when available, expensive, the only alternative will be to live along with the so called dentist created malocclusion.

The final outcome of the writers thesis is as far as possible conservation of the deciduous molars should be given prime importance, even if its root stumps, it should be left in place until exfoliation. In events where there is premature loss of deciduous teeth, a space maintainer must always be considered and a careful review of the patient maintained. In cases of deciduous teeth lost prematurely by 2 years or more space maintainers will definitely play an important part. The ultimate outcome of the above study is space maintainers will definitely play a role in a developing country in cases where deciduous teeth are lost prematurely. Emphasis must always be to use the deciduous teeth as "Nature's space maintainers".
REFERENCES

Baker CR (1920).
A consideration of the exchange of deciduous teeth for permanent teeth.
JADA 7:257-265.

Brandhurst OW (1932).
Promoting normal development by maintaining the function of deciduous teeth.
JADA 19:1196.

Brauer JC (1941).
A report of 113 early or premature extractions of primary molars and the incidence of closure of space.
J Dent Child 8:222-224.

Sequelae of early loss of deciduous molars.

Further observations on early loss of deciduous molars.

How much orthodontics shall the pedodontist do?

Effect of extraction of deciduous molars on the eruption of bicuspid teeth.

Chapman H (1927).
Orthodontics:
The necessity of histories to establish etiology; the necessity of extra function in retention; the necessity of preserving spaces closed by premature loss of deciduous teeth.

Cohen JT (1941).
The selection of cases for space maintainers.
North West Dent April:75-82.

Conover CS (1928).
Deciduous teeth. Effects of too early loss and too long retention.

Curley JE (1931).
The deciduous molars, nature's space retainers.
JADA 18:1650-1662.
Davey KW (1967).
Effects of premature loss of primary molars on the anteroposterior position of maxillary first permanent molars and other maxillary teeth.

Davis GN, King RM (1961).
Dentistry for the preschool child.

Arch length deficiencies in the mixed dentition.

Gron AM (1962).
Prediction of tooth emergence.

Child dental health.
Bristol: John Wright and Sons 98-109.

Humphrey WR (1951).
Dentist responsibility in the prevention of malocclusion.
JADA 18:1607-1615.

Kantorowicz H (1927).
The self correction of orthodontic anomalies.

Keneddy DB (1976).
Paediatric operative dentistry.
Bristol: John Wright and Sons 188-191.

Kronford SM (1953).
The effect of premature loss of primary teeth and sequence of eruption of permanent teeth on malocclusion.

Lewis S (1936).
Ectopic eruption of permanent teeth as a factor in premature loss of deciduous teeth.
JADA 23:1019-1027.

Lundstrom A (1976).
The significance of early loss of deciduous teeth in the etiology of malocclusion.
J Dent REs 56:819-827.

Lundstrom A (1951).
The etiology of crowding of teeth and its bearing on orthodontic treatment.


