Manual of

RETAINERS IN ORTHODONTICS

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Dedicated to

My beloved Grandfather
Dr Chittrambalam G

FOREWORD

Orthodontic treatment has experienced a wide acceptance within the normal population in the last few decades and mainly younger people seek for a perfect smile. The appliances turned to become more and more sophisticated, therefore, mild as well as severe dental malocclusions could be treated with a high success rate. Conversely numerous publications describe remarkable relapses in several occlusal traits, especially the alignment of the anterior teeth. The relapse in orthodontic treatment is associated to various aspects, including periodontal and occlusal factors, pressure from the oral soft tissue and growth. Therefore, orthodontic retainers have the substantial function of providing stability for the outcome achieved at the end of the treatment. Several devices are used for orthodontic retention either they are removable or fixed. This book reviews the principles for the use of retention following orthodontic treatment and describes all the different types of retainers currently used for this purpose. As healthcare professionals, we should always consider the patient‘s desire for improvement of the quality of life, but we should also keep the achieved results over a long period of time. Retainers are certainly not the attractive part of the orthodontic treatment, but they are the key for a long lasting beautiful smile.

Thierry Vuillemin Dr Med Dr Med Dent
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FOREWORD

I am delighted to write this Foreword to the *Manual of Retainers in Orthodontics* authored by Dr Prithiviraj, an Orthodontist.

This book is an outstanding presentation in specialty of Orthodontics by Dr Prithiviraj. This book is the original work of the author and reflects his dedicated contribution in this field.

The language used is simple and lucid. All the chapters are well referenced with case reports/figures and well-defined illustrations for much easy understanding of the subject. Advanced techniques on the clinical management in orthodontics are well projected with distinguishing features on research. The book delivers a deep rooted knowledge on the subject.

In short, it is a standard textbook useful for undergraduates, post-graduates and the practitioners as well.

I am sure that the book will be widely received and the student's fraternity will greatly benefit.

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PREFACE

This *Manual of Retainers in Orthodontics* is an all-inclusive primer, which is essentially deemed to provide dental students and practitioners an insight into orthodontic retainers. It also provides expedient information on a wide array of retainers that have been used in the past with no intent of remarking the benefits of one over the other.

Given that there is a dearth of a comprehensive account of orthodontic retainers, the theme harbored interest, which stemmed the idea behind the conception of this manual. This manual presents various clinical scenarios with supporting literature substantiation, assisting the reader with easier preferences during their clinical practice.

With the future of orthodontics hurtling at a swift pace, there would be a need to revise this manual to expand prospects for readers of orthodontics.

Prithiviraj Jeyaraman

ACKNOWLEDGMENTS

I am extremely happy to bring out my first book. I thank His Holiness Sri Sri Ganapathi Sachidananda Swamiji, my Lord and my Guru for leading my way through difficult times and making this book happen. I am indebted to my parents who brought me to this world; especially my father Dr Jeyaraman C who introduced me into the wonderful world of dentistry.

My sincere thanks to all my teachers especially my Principal Dr Srinivasan B, my guide Dr Vijayalakshmi K, for being patient with me all through my student years and making me what I am now. I thank Dr Vuillemin who is an inspiration and model to me and whom I follow in everyday practice.

My heartfelt thanks to Dr Dhanasekhar and Dr Aparna for their help and support in bringing out this book, and also to Dr Saptarishi for his help.

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CONTENTS

1 Introduction

RETENTION

One of the most important aspects in orthodontic treatment is retention. Orthodontic treatment results are potentially unstable and therefore, retention is necessary for three reasons.

The three reasons are as follows:

1. The gingival and periodontal tissues are affected by orthodontic tooth movement and require time for reorganization when the appliances are removed.
2. Changes produced by growth may alter the orthodontic treatment results.
3. The teeth may be in inherently unstable position after the treatment, so that soft tissue pressures constantly produce a relapse tendency.

The tendency of the teeth to move back from post-treatment to the pretreatment position is relapse. Orthodontists have long since been aware of the fact that teeth that have been moved in or through the bone by mechanical appliances have a tendency to return to their former position.

Retention in relation to orthodontics can be defined as the holding of teeth in ideal esthetic and functional positions. The type of retentive measures and the duration of their use are determined by how many teeth have been moved and how far, the occlusion and age of the patient, the cause of a particular malocclusion, the rapidity of correction, the length of cusps and health of tissues involved.

Retention Planning

Retention planning is divided into three categories depending on the type of treatment instituted:

1. Limited retention.
2. No retention.
3. Prolonged or permanent retention.

Retainer

Many appliance types have been used for the retention of post-treatment tooth position. The first appliances proposed were bonded or banded fixed appliances, then removable retainers were advocated. Most recently the uses of bonded fixed retainers have been introduced:

1. The retainers can be classified into removable, fixed or a combination of both. The fixed retainer provides a greater degree of support and control than a removable retainer.
2. A fixed retainer is commonly bonded to the lingual of the lower anterior teeth following a fixed appliance treatment, while a removable retainer remains the retainer of choice for the maxillary arch.

The purpose of this book was to obtain detailed information about retention, stability, relapse and mainly on various type of retainers used in orthodontics.

2 Retention

Retention is one of the controversies of modern orthodontics, with uncertainty being the only certainty. Angle stated that "the problem involved in retention is so great as to test the utmost skill of the most competent orthodontist, often being greater than the difficulties being encountered in the treatment of the case up to this point". Retention according to Joondeph and Riedel is the holding of teeth in ideal esthetic and functional position.

Joondeph and Riedel attempted to rationalize the problem and summarized his findings in three statements:

1. Teeth moved through bones by orthodontic appliances, often have a tendency to return to their former positions.
2. Arch form, particularly mandibular arch form cannot be permanently altered by appliance therapy.
3. Bone and adjacent tissues must be allowed time to reorganize after treatment.

Planning for and executing retention are the most difficult elements of the clinical orthodontic practice. No means are yet available to help predict relapse or to give objective advice about duration of retention. It is apparent that our knowledge of the variables contributing to post-treatment relapse remains incomplete, but any attempt at planning the retention phase requires some semblance of rationality in so far as possible.

FACTORS

The six factors important in the planning of this phase of treatment:

1. Obtaining informed consent.
2. The original malocclusion and the patient's growth pattern.
3. The type of treatment performed.
4. The need for adjunctive procedures to enhance stability.
5. The type of retainer.
6. The duration of retention.

The type of retentive measures and the duration of their use allegedly are determined by:

1. How many teeth have been moved, and how far?
2. The occlusion and age of the patient.
3. The cause of a particular malocclusion.
4. The rapidity of correction.
5. The length of cusp and health of the tissues involved.
6. The relationships of the inclined planes.
7. The size of the arches or arch harmony.
8. The muscular pressure.
9. The approximal contact.
10. The cell metabolism and atmospheric pressure.

The position of teeth in the dental arch is dictated primarily by the shape and the relationship of the jaws, and by forces from the surrounding soft tissue. Following a course of orthodontic treatment, the teeth should be in a position of balance, but a period of retention is still usually necessary to allow the supporting tissues to adapt. In rare cases, permanent retention is required. A distinction should be made between relapse of orthodontic treatment and changes that are a result of facial growth and occlusal maturation. For the patient, these changes are undesirable whatever the cause, but the clinician should recognize their different etiologies. Relapse should be anticipated and avoided, but the prediction of facial growth changes is much more uncertain. The clinician should be aware of the possibility of the unfavorable occlusal changes and should warn the patient accordingly.

TYPES

Following orthodontic treatment, the occlusion may be self-retentive, as when an upper incisor is moved over the bite and no retention appliance will be required. Unless there is positive occlusal retention of the treatment result, it is usual to fit a retainer at least until the supporting tissues have reorganized fully. Retention can be short-term, medium-term and permanent retention.

Short-term Retention

Short-term retention extends from 3 to 6 months, while the supporting tissues are reorganized. Removable appliances are the

most useful because it can be worn only part time towards the end of the retention period.

A typical regime would be full-time wear for the first 3 months followed by nights only wear for a similar period. The advantage of concluding retention with part-time wear is that if the teeth become more mobile or if the appliance is difficult to insert after it has been left out, this indicates that the tooth positions may be not stable. There is little merit in then extending the retention period in the hope that things will improve.

Medium-term Retention

Medium-term retention is appropriate where the supporting tissues will take a longer time to adapt or where it is decided to stabilize the occlusion during the later stages of the facial growth, so that dentoalveolar adaptation does not results in adverse occlusal changes and in particular, in lower incisor crowding. Medium-term retention may extend from 1 to 5 years. A fixed retainer will generally be used and although some orthodontists use positioners in this capacity. It should be used only where there are clear indications that it will be beneficial and not merely to postpone the inevitable relapse of an unstable treatment result.

Permanent Retention

Permanent retention (long-term retention) can be justified only in exceptional circumstances, e.g. in the patient with a cleft of the lip and palate where a prosthesis can act as retainer and in adult patients with periodontal problems where there is no alternative, but to stabilize the teeth permanently.

Clinicians who fully grasp the underlying principles of retention, who appreciate its difficulties and who are able and willing to devote to it that high order of mechanical skills, which adequate retaining devices demand will find few things in dentistry, which bring quite the satisfaction and permanent pleasure as the branch they have chosen to practice (orthodontia). *—Calvin Case, 1980*

Stability 3

SCHOOL OF THOUGHTS ON RETENTION

Stability is the condition of maintaining equilibrium. This refers to the condition of being stable.

There are four schools of thoughts on retention:

1. Occlusion school (Kingsley): According to this school, a proper occlusion of teeth is a potent factor in maintaining the stability of the teeth. At the end of active treatment, there should be proper intercuspation and interdigitation. There should be cusp-to-fossa relationship between maxillary and mandibular teeth.
2. Apical base school (Axel Lundstrom): Apical base is one of the most important factors in both correction of malocclusion as well as maintenance of correct occlusion. Intercanine and intermolar width should not be altered.
3. Mandibular incisor school (Grieve and Tweed): The mandibular incisors should be placed upright and over the basal bone.
4. Musculature school (Rogers): Establishing proper functional muscle balance is a must to achieve stable occlusion.

THEOREMS ON RETENTION

The theorems on retention are as given below.

Theorem 1

Teeth that have been moved tend to return to their former positions.

There seems to be general agreement that teeth should be held in their corrected positions for sometimes after changes are made in their positions. Only a few orthodontists have suggested that retention is routinely unnecessary.

Theorem 2

Elimination of the cause of malocclusion will prevent recurrence.

Until more is known about the causative factors that are related to particular types of malocclusion, little can be done about their elimination. When obvious habits, such as thumb or finger sucking or lip biting are causes of malocclusion, little difficulty is presented in diagnosis. It is important one of the most insidious habits that operate against satisfactory retention is tongue posture, which results in anterior and sometimes lateral open bites. The mere fact that patient has been directed along a course of tongue therapy and has been able to meet all the exercise requirements of the therapist on command does not guarantee correction.

Theorem 3

Malocclusion should be over corrected as a safety factor.

It is common practice on the part of many orthodontists to over correct class II malocclusions into an edge-to-edge incisor relationship. One must be aware, however, that these over corrections may be the result of overcoming muscular balance rather than absolute tooth movement.

One of the most irritating types of relapse is the tendency for a previously rotated tooth to attempt to rotate toward its former position. Over rotation has not often been carried out and there is no evidence to indicate that it is successful in preventing return to former position. It is often possible to prevent anterior teeth from erupting in a rotated position by providing space for them to erupt unimpeded, either by orthodontic appliances or by the early extraction of deciduous teeth.

Theorem 4

Proper occlusion is a potent factor in holding teeth in their corrected positions.

From the standpoint of reducing the potential of irritations to the periodontium, an excellent functional occlusion is certainly to be desired. Orthodontists often blame over function or pounding of the mandibular canines by the maxillary canines for relapse in the mandibular anterior area. The everyday evidence presented by the

tremendous wear that many teeth undergo would indicates that they do not move in response to repeated grinding and tapping, until bone has been so thoroughly destroyed as not to prevent their migration or until fibrous tissues builds up to such a degree that it actually moves the teeth and function of these teeth is not possible. Certainly we have all observed instances of mandibular anterior irregularity of collapse, in which canines, either have not yet erupted or are not actually in occlusion. Studies evaluating stability of mandibular arch show no difference in long-term response between patient with anterior tooth contact when compared to individuals with anterior open bite malocclusion devoid of canine contact in centric positions and functional excursions. It is doubtful that proper intercuspation or interlocking is the most potent factor in retention.

Theorem 5

Bone and adjacent tissues must be allowed time to reorganize around newly positioned teeth.

Some type of either fixed or rigid appliance only inhibitory in nature and not dependent on the teeth should be used. Histologic evidence shows that bone and tissues around teeth that have been moved are altered and considerable times elapse before complete reorganization occurs. Present day orthodontic concepts, however, regard bone as being a plastics substance and considered tooth position to result from equilibrium of the muscular forces surrounding the teeth. The placement of retentive appliances, then, is an admission of inadequate orthodontic correction or of a predetermined decision to place teeth in relatively unstable positions for esthetic reasons. Whether stability increases with prolonged retention is the one of the most interesting points of discussion in regard to retention planning and is the phase of treatment that is most difficult to quantify.

Theorem 6

If the lower incisors are placed upright over the basal bone, they are more likely to remain in good alignment.

Therefore attention should be directed to the proper angulation and placement of the mandibular incisor segment. It is obvious that the difficulty of evaluating this contention revolves around proof of the fact that incisors have been placed upright over the basal bone.

We have been able to define upright: perpendicular to the mandibular plane, 5° or some specified angulation to the occlusal plane or Frankfort horizontal plane, etc. however, no one can specify where basal bone begins or ends and there seems to be no satisfactory method of measuring it.

It has sometimes been assumed that teeth that are upright are also over the basal bone. However, there are cases in which the roots of mandibular incisors have been moved labialy to a considerable degree in the process of uprighting these teeth. It is significant that many malocclusions present with mandibular incisors upright and 'over basal bone' and yet these teeth are both crowded and rotated. Teeth are supposedly having the very attributes of stability can be in a state of malocclusion.

If the patient is growing, the mandibular anterior segment may exhibit a physiologic migration in relation to the mandibular body in a distal direction that is apart from orthodontic treatment. It can be readily seen, if the mandibular anterior section is moved lingually during orthodontic treatment, this movement may be in harmony with the normal expected migration of these teeth; hence, retentive care may be minimized. However, we believe that mandibular arch form plays a more important role in stable mandibular tooth alignment than does the relative anteroposterior relationship of mandibular denture to base.

Theorem 7

Corrections carried out during periods of growth are less likely to relapse.

There seems to be little direct evidence to substantiate this statement, but it is logical. If orthodontists are in any way able to influence growth and development of the maxilla or mandible, then certainly it is logical to presume that growth can be influenced only, while the patient is growing.

Early diagnosis and treatment planning appear to afford several advantages in long-term stability. Institution of early treatment can prevent progressive, irreversible tissue or bony changes, maximize the use of growth and development with concomitant tooth eruption, allow interception of the mild occlusion prior to excessive dental and morphologic compensations and allow correction of skeletal malrelationships, while sutures are morphologically immature and more amenable to alteration.

Much has been said about changes in muscle balance established by changing a position of teeth, which in turn will promote rather than retard normal growth. Whether malrelations in muscle balance have as much influence on growth and development as has been supposed is difficult to say. It might be mentioned that changes in muscle balance in normal direction would allow for more normal development of the dentition, in relation to retention, normal muscle balance should allow for normal arch alignment.

Theorem 8

The further teeth have been moved, the less likelihood there is of relapse.

When it has been necessary to move teeth a great distance the patient will probably need less retentive attention or perhaps it is desirable to move teeth further during the process of orthodontic treatment.

It is possible that positioning far from the original environment will produce equilibrium states permitting most satisfactory occlusions. There is little real evidence to support the statement that the further teeth have been moved the less relapse tendency they will have. In fact, the opposite may be true. It may be more desirable through guidance of eruption and early interception of skeletal dysplasias to minimize the need for future extensive tooth movement, with the resultant impact on the functional environment and such local factors as supracrestal fibers.

Theorem 9

Arch form, particularly in the mandibular arch, cannot be permanently altered by appliance therapy.

Therefore treatment should be directed toward maintaining the arch form presented by the malocclusion as much as possible. The evidence brought to our attention by Hayes Nance and others, that attempts to alter mandibular arch form in the human dentition generally meet with failure, has been accepted realistically by some orthodontists.

OCCLUSAL AND SOFT TISSUE FACTORS

Soft Tissue Factor

An occlusion before orthodontic treatment is in balance between occlusal and soft tissues force, unless a new position of balance can be found, changes will not be stabled. As general rule the size and the form of the lower arch has to be accepted. Lower arch width is particularly difficult to alter with the assurance of stability and so this should not be done without good cause. Cases can be found where transverse lower arch expansion has been stable, but this is predictable and so is not sound basis for treatment.

Labiolingual movement of lower incisors is also liable to be unstable unless other factors are changed at the same time. For example, retraction of the lower incisors may be stable in a class III case, if an adequate overbite is established. In a few class II cases, the lower incisors have been restrained by contact with palate or upper labial segment or by the thumb sucking habit and so proclination to a position of true soft tissue balance will be stabled.

However, these changes in the lower incisor position are problematic and have to be managed skillfully. Retraction of upper incisors in class II division 1 case will be provided stability their relationship to the lower lip is changed.

Occlusal Factor

Teeth that are retained by the occlusion will be stable, without retention appliances. For example, in standing upper incisors that have been moved over the bite will be provided stability that the overbite is adequate. Similarly, a unilateral crossbite corrected by upper arch expansion should be stable, if there is a good intercuspation of the teeth. The occlusion is also important in maintaining a corrected anteroposterior arch relationship.

FACIAL GROWTH AND OCCLUSAL DEVELOPMENT

Dentoalveolar adaptation tends to maintain occlusal relationships, even when skeletal relationship changes with growth. However, if the intercuspation of the teeth is poor or if the dentoalveolar compensation is already at its limit, occlusal changes are marked.

For example, a class III occlusion will often deteriorate, if the underlying class III skeletal relationship becomes more severe and a skeletal open bite often becomes worse with growth in lower face height.

Supporting Tissues

In normal circumstances, transient variation in occlusal and muscular forces will not result in tooth movement. However, when a tooth has been moved by an orthodontic appliance, the recently deposited bone is particularly susceptible to resorption. Thus relapse can occur due to minor imbalances that would normally have no effect. For this reasons it is prudent to retain most tooth movements for a period of months until the supporting tissues have adapted fully. The supporting bone and principal fibers of the periodontal ligament will be reorganized within 3–6 months, but supra-alveolar connective tissue takes very much longer. This can produce partial relapse of rotations and of labial movement of instanding lateral incisor teeth unless they are held by an overbite. Precision of the free gingival and transseptal fibers following rotation helps to stabilize the correction, although it does not eliminate the risk of relapse.

4 Relapse

Relapse is essential after active treatment to establish as perfect a state of balance as possible and to maintain the teeth until all retrogressive changes are eliminated or reduced to a minimum. It is essential that the dentist has a board biological orientation—that he recognizes not only the predominance of the morphogenetic pattern, but the role played by the environment, by the functional forces and by the effect of restorative work on the integrity of the dentition.

Basically, there are morphologic and biologic reasons for relapse. To better understand the morphologic aspect, an analysis of tooth movement itself is essential.

The foregoing would seem to imply that the tendency to relapse is strongest when the tooth is moved quickly. In general, this is true and rapidity of orthodontic correction is not necessarily a favorable treatment objective. Indeed, it can enhance the tendency to return to the original malocclusion.

In the final analysis, one of the important factors in preventing relapse are the choice of the proper treatment philosophy and appliance themselves. This means a careful diagnostic routine and a constant evaluation of treatment progress. The orthodontist must be willing at all time to reassess and changes treatment, if indicated. To expand, to extract, to treat now, to treat later; these are important decisions that must be made, but from a thorough assessment of all diagnostic criteria.

5 Retainers

TYPES OF RETAINERS

Retainers are used in orthodontics to hold teeth either actively or passively. Active retainers are used to move teeth, while passive retainers are commonly prescribed at the end of active orthodontic treatment to provide adequate support for the teeth in the post-treatment phase. They may be removable, fixed or a combination of both (Table 5.1).

Table 5.1: Types of retainers

Removable retainers	Fixed retainers
Hawley retainer	Bonded flexible retainer
Wraparound retainer/clip-on retainer	Lower lingual bonded retainer
Non-acrylic removable retainer	Active retainer
Positioner retainer	Spring retainer
Essix retainer	Activable retention technique
Functional appliance	

Fixed Retainer

The fixed retainer provides a greater degree of support and control than a removable retainer. While a removable retainer remains the retainer of choice for the maxillary arch, fixed retainers are primarily used to retain derotated teeth and periodontally-involved teeth. One of the disadvantages of a fixed retainer is the hygienic problem of not being able to floss or brush.

Removable Retainers

Removable retainers on the other hand are generally easier to maintain hygienically and provided greater freedom for later modification in the case of relapse. But are easily lost or broken by patient negligence.

Removable Retainers

6

HAWLEY RETAINER

Hawley retainer is constructed with 0.7 mm wire. Flexibility depends largely on the vertical height of the loops. However, sulcus depth is limited and because the wire is heavy, these bows are very rigid in the horizontal plane. Conversely, these are flexible in a vertical direction and so the stability ratio is poor.

Hawley retainers of all types, classic and modified, remain the most widely used retainers in orthodontic therapy. In addition to their role in retention, these can be modified to achieve some limited active tooth movement through the activation of the labial bow or incorporation of auxiliary springs embedded into the acrylic base or soldered to the labial bow or clamps (Figs 6.1A and B).

Hawley retainers can be used to achieve slightly individual tooth movement. These are especially effective in overbite cases, since the overbite correction can be maintained or even increased by building a flat or slightly inclined shelf into the acrylic plate behind the incisors.

Tweed advised that retainers should normally be worn for at least 5 years to ensure functional adaptation to orthodontic corrections.

Figs 6.1A and B: Removable retainer. **A.** Hawley retainer; **B.** After application.

Passive retainers are used:

1. To maintain the status quo within the dentition (e.g. space maintainers and retaining appliance).
2. To disclude the dentition during orthodontic treatment.
3. To disclude the teeth prior to registration of bite relationships.
4. As an adjunction to the treatment of temporomandibular dysfunction.

It is the most common retainer. It incorporates clasps on molar teeth and characteristic outer bow with adjustment loops, spanning from canine to canine.

The ability of this retainer to provide some tooth movement was a particular asset with fully banded fixed appliances, since one function of the retainer would close band spaces between the incisors. A common modification of Hawley retainer for use in extraction cases are bow soldered to the buccal section of Adams clasp on the first molar, so the action of the bow helps hold the extraction site closed.

It is made of acrylic base with molar clasps and an anterior labial bow with vertical adjustment loops located in the canine region. The acrylic may completely cover the palatal mucosa or may be constructed in a horseshoe shape contacting the palatal surface of teeth and some of the palatal mucosa. The labial bow (0.508–0.914 mm diameter wire) is constructed to contact the labial surface of the first premolars or the first molars in maxillary teeth. This is a classic feature of a Hawley retainer.

The labial bow crosses the occlusion distal to the canine; it has a tendency to open spaces at the site, especially in cases where treatment involved extraction of first premolars. In these instances, a continuous labial bow that is soldered to the molar clasps or a wrap-around bow that also acts as clasps should be considered. The continuous wrap-around bow or a bow soldered to a circumferential clasp has the advantage of having no wire passing over the occlusal surface of the teeth and can be adjusted further to maintain closure of any extraction site.

In another modification of the basic Hawley's appliance, the labial bow crosses the occlusal table distal to the lateral incisors and utilizes a short distal extension soldered to the distal leg of the vertical loop in order to control canine position. In most cases, replacing a portion of labial bow with elastic across the incisor teeth is found to be more acceptable to adult patient. However, what is gained in esthetics is lost in incisor control.

Hawley retainers are usually worn 24 hours per day for the first 6 months following removal of therapeutic appliance. Exceptions to the 24-hour constraint are for toothbrushing, swimming, physical contact sports and eating.

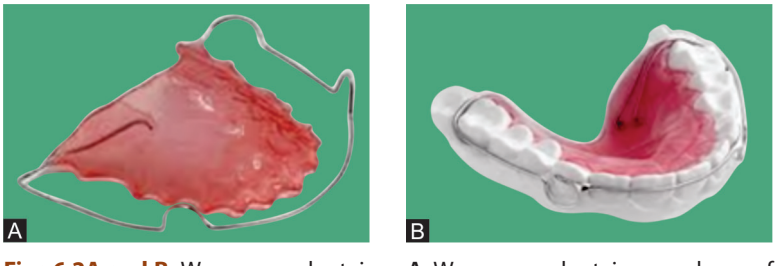
Since Hawley type retainers are fabricated from acrylic, these are easily modified to include acrylic teeth and thus are used as a transitional partial denture prior to the construction of fixed and/or removable partial denture prostheses.

Removal for eating creates the hazard that the appliance will be thrown out, while wrapped in napkin; patient therefore have to be admonished that their retainers belong either in their mouth or in the retainer case.

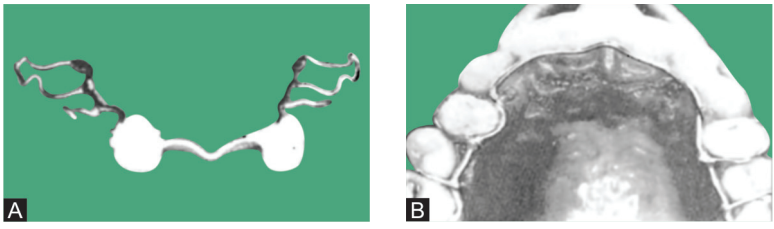
WRAP-AROUND RETAINER

A second major type of removable orthodontic retainer is the wrap-around or clip-on retainer, which consists of plastic bar (usually wire-reinforced) along the labial and lingual surfaces of the teeth. It is made up of 0.7 mm stainless steel wire. A variant of the wrap-around retainer, a canine-to-canine clip-on retainer, is widely used in the lower anterior region (Figs 6.2A and B).

The wrap-around Hawley is often the clinicians' alternative when occlusal inferences exist with a traditional Hawley retainer. The wrap-around design eliminates occlusal interferences or opening interproximal contacts. This design is often the second choice retention appliance due to the long span of the labial arch wire. The great distance between supports leaves the labial wire susceptible to distortions, if the patient uses the wire to remove the appliance. Patients should be instructed to 'scoop' the appliance out from the palate with their thumb or index finger.



Figs 6.2A and B: Wrap-around retainer. **A.** Wrap-around retainer made up of plastic bar and stainless steel wire; **B.** Wrap-around retainer in lower anterior region.



Figs 6.3A and B: Non-acrylic removable retainer. **A.** Appliance; **B.** After application.

NON-ACRYLIC REMOVABLE RETAINER

Removable appliances with an acrylic base may cause soft tissue inflammation in patients who tend to accumulate plaque or are hypersensitive to free monomer, especially when cold-curing acrylic is used. A non-acrylic removable retainer is a simple, effective alternative (Figs 6.3A and B).

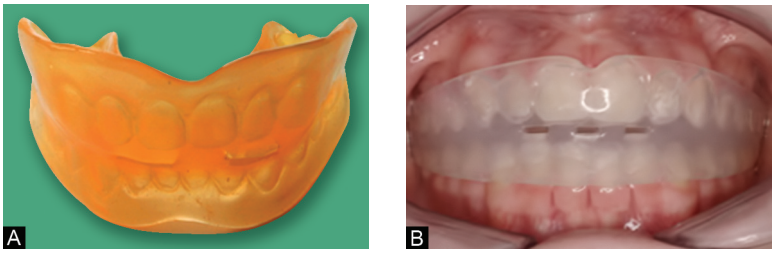
A special appliance was designed to resolve the inflammation. The non-acrylic removable retainer was constructed of heavy wire (0.9 mm) adapted to the gingival palatal surfaces of the upper teeth. Retention was gained with Adams clasp on the first molars and three-quarter clasps on the first bicuspids.

POSITIONER APPLIANCE

Positioner appliance is employed in some practices. It could be found in two forms; the preformed and the custom-made. It acts as a wonderful interim appliance, bridging the span between the multiband appliances and the conventional retainers. These appliances have been available for many years in either rubber or plastic. Their efficacy has never been suspect; the only questionable aspect is their dependence upon the cooperation of the patient (Figs 6.4A and B).

Since the introduction of the positioner retainer by Kesling in 1945, various materials including rubber, thermoplastic vinyl and resin have been described.

In 1977, a high elastic silicone elastomer made of polydimethyl silicate was introduced. Although the common silicone elastomers are biologically inert and have excellent mechanical properties, these have not been widely used in orthodontic practices. Reasons may



Figs 6.4A and B: Positioner retainer. **A.** Tooth positioner; **B.** Application of tooth positioner.

include the time and cost of fabrication, the uncertainty of clinical performance and the need for patient cooperation.

This is another type of retainer that is frequently used. This is a flexible splint made from synthetic rubber or plastic material into which the patient bites.

Custom-made

Custom-made is fabricated on an articulated model in which the teeth from both arches have been sectioned from their base, realigned and waxed in an ideal configuration, thus incorporating minor correction in tooth posture and occlusal inter-relation. It is then fabricated by forming the rubber or elastomeric material around the teeth and the coronal portion of the gingiva. When cured or set, the appliance will have the ability to settle teeth and to achieve some limited tooth movement because of its inherent elastic properties.

Preformed

Preformed types are available in different sizes and types for non-extraction, for premolar extraction and maxillary premolar extraction cases. The sizes are usually based on the sum of mesiodistal diameter of the maxillary anterior teeth. These should be used only on temporary basis, because these appliances cannot compensate for individual variation in the size of the teeth, tooth size discrepancies and variation in the width of the arch and form.

These appliances are worn nearly 24 hours per day as possible for the first 2 days. After that, the appliances can be removed and

then wear for 4 hours per day plus during sleeping. For 4 hours per day during the first 2 days then during the 4 working hours of wear, the patient is requested to bite and clench into the appliance for 20 seconds, release for 20 seconds and repeat. If the patient follows this schedule, after the first 2–3 weeks, all movement that might occur will have done so and the appliance will become a true 'passive' retainer rather than an active appliance.

It is used for tooth positioning and enhancing the settling or 'time tuning'. It also can stimulate and massage the gingiva during the excessive aspect of their use.

It can maintain the occlusal relationship and interarch tooth position. In patient that has a tendency toward class III relapse, a positioner made with the jaws rotated somewhat downward and backward may be useful. It is also clean, unlikely to be broken and tends to stimulate tissue tone and works constantly toward the improvement of tooth position.

The cost of fabrication is high because of the extensive laboratory procedures and the time also being delayed because of the fabrication. It lacks the ability to maintain the correction of rotated teeth. It is also allowing the overbite to reassert itself. Its limited time of wear (since the patient can neither eat nor talk with the positioner in place) and the possibility that it may keep teeth loose by producing intermittent forces contrary to natural muscle balance. It is contraindicated in patient who has a tendency for blocked nasal airways.

It is bulky and can interrupt speech. The pattern of wear of a positioner does not match the pattern that is usually derived for retainers. Because of its bulkiness, patient often has difficulty in wearing a positioner on a full-time basis. In fact, the positioner tends to be worn less than the recommended 4 hours per day after the first 4 weeks. The preformed types have serious limitations unless one can be found that fits the occlusion precisely, these may be ineffective as retainers and may even induce tooth movement. In fabricating a positioner, it is necessary to separate the teeth by 2–4 mm. This means that an articulator mounting that records the patient's hinge axis is desirable. As a general guideline, the more the patients deviates from the average normal and the longer the positioner to be worn, the more important it is to obtain an individualized hinge axis mounting an adjustable articulator for positioner construction.

ORGANIC POLYMER WIRE FOR ESTHETIC MAXILLARY RETAINERS

Patients who have worn esthetic ceramic or plastic brackets during orthodontic treatment are likely to want esthetic retainers after treatment. Although fixed lingual mandibular retainers are inconspicuous, the popular Hawley type maxillary retainers include highly visible labial wires (Figs 6.5A and B).

An organic polymer maxillary retainer wire is made from 1.6 mm diameter round polyethylene terephthalate. This material can be bent with a plier, but will return to its original shape unless it is heat treated for a few seconds at a temperature less than 230°C (melting point). In prefabricating this QCM retainer wire, the anterior portion of the wire and the 'wave' portion are heat treated at about 150°C immediately after bending. The anterior portion is left flat to minimize patient discomfort.

The organic polymer for esthetic maxillary retainer wire showed a modulus of elasticity similar to that of the flat bow retainer wire. After heat treatment, it displayed little deformation. The shrinkage that occurs with heating allows the wire to fit more snugly to the cast and the reduction in shrinkage of overall length can be compensated for by extending the 'waves'.

More was observed in the posterior portions of the wire than that in the anterior portion. This is because the anterior segment and the 'waves' are initially heat treated at 150° to form the retainer.

The organic polymer wire retainer has highly desirable esthetic characteristic and suitable physical properties. Patients who have

Figs 6.5A and B: Esthetic maxillary retainer. **A.** Organic polymer wires; **B.** Application of maxillary retainer.

worn it to date have been entirely satisfied and hence more likely to comply with long-term retention.

Wire bending is rarely necessary with the retainer. Since it is shaped simply by pressing it tightly against the working cast, it reduces laboratory construction time. The retainers can be made entirely of this type of wire or with metal posterior segments. For either type, a maxillary impression is taken and the cast is left to dry at room temperature. If necessary, activation loops can be added or spring can be welded to the metal wires.

Organic polymers are used in many orthodontic materials today because of their esthetic qualities. This polymer can be join with a metal at the posterior segments, because the polymer is too thick and it is impossible to be used on terminal molars that have not fully erupted or are out of occlusion at the end of active treatment.

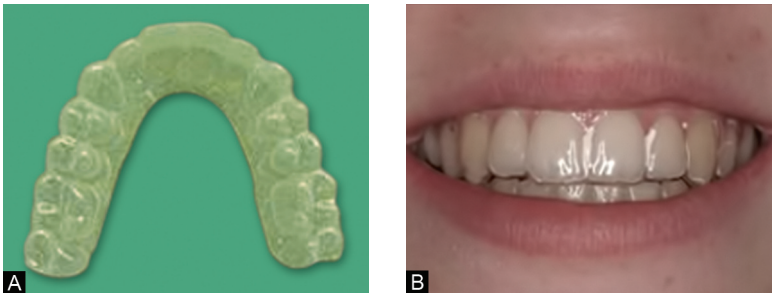
Organic polymer wires generally have low elasticity and thus these are easily deformed and do not exert sufficient force for tooth movement and retention. If the wires are made with a high modulus of elasticity, these become brittle. Organic polymers also discolor because of their tendency to absorb liquids. These polymers are made into wire are thicker than traditional retainers, which can make it impossible to use on terminal molars that are not fully erupted or are out of occlusion at the end of active treatment.

INVISIBLE RETAINERS

Invisible retainers usually last for many months to a few years. The standard appliances made of wire and acrylic or of rubber usually last for many years. Invisible retainer fits as accurately as the impression and model permit. Usually, no adjustment needed (Figs 6.6A and B).

Occasionally, the periphery will require reduction for the attachments of muscles. Heat guns can be used to join cracks, separations or split areas in the plastic. Usually, it is preferable to make a new appliance after considerable wear has occurred. The ease of fabrication, the speed of insertion and almost complete lack of need for adjustment have amazed all who have used these appliances. It is usually easier to remake than to repair an invisible retainer.

Periodontists have found invisible retainers valuable for keeping surgical packs in place with maximum comfort for the patient. These appliances have been used successfully as splints to stabilize traumatic and surgical fractures of the maxilla, premaxilla and mandible until the bony fragments heal.



Figs 6.6A and B: Invisible retainer. **A.** Appliance; **B.** After application.

Webbing or folding of the appliance upon itself is a common problem encountered in the use of these thermoformed materials. Usually this fault comes from excessive temperature when the appliance is being formed.

ESSIX RETAINERS

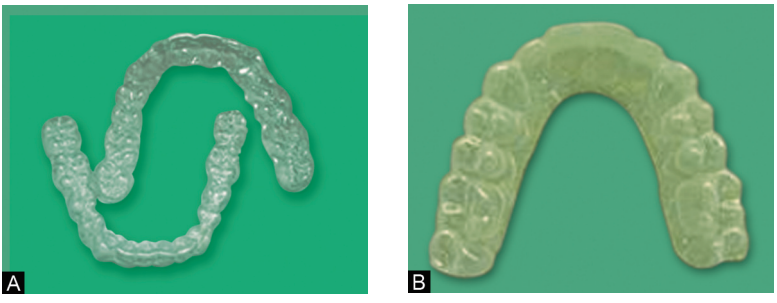
Essix retainers have nothing to adjust; the only thing that could be done on a recall visit would be to check the patient's compliance and listen to any comments. Telephone supervision is a time- and money-saving service to the patients and is sincerely appreciated.

Essix thermoplastic copolyester retainers change the rules of permanent retention. Essix retainers are thinner, but stronger, cuspid-to-cuspid version of the full arch, vacuum formed devices (Figs 6.7A and B).

Advantages include:

1. The ability to supervise without office visit.
2. Absolute stability of the anterior teeth.
3. Durability and the ease of cleaning.
4. Low cost and ease of fabrication.
5. Minimal bulk and thickness (0.381 mm).
6. The brilliant appearance of the teeth caused by light reflection.

Since Essix retainers are placed only on the anterior teeth, these were particularly monitored for signs and symptoms of open bite. After hundreds of observations, there were few signs and a complete absence of symptoms.



Figs 6.7A and B: Essix retainers. **A.** For both jaws; **B.** For single jaw.

This retainer has proven quite versatile. Their flexibility and positioner effect makes them an alternative to spring retainers. These also can serve as a temporary bridge and night guards for bruxism and as bite planes to relieve bracket impingement until the bite can be opened.

The use of Essix retainer in combination with telephone monitoring opens the way to a practical, patient-friendly method of true permanent retention.

Active Retainers

7

'Active retainers' are contradictions in terms, since a device cannot be actively moving teeth and at the same time, serving as a retainer. It does happen, however that a relapse or growth changes after the orthodontics treatment will lead to a need for some tooth movement during retention. This is usually accomplished with a removable appliance that continues as a retainer after it has repositioned the teeth, hence the name. A typical Hawley retainer, if used initially to close a small amount of band space, can be considered as an active retainer. But the term is usually reserved for two specific situations; realignment of irregular incisors and functional appliance (refer Chapter 8, Functional Appliances) to manage class II or class III relapse tendencies.

REALIGNMENT OF IRREGULAR INCISORS

Recrowding of lower incisors is the major indication for an active retainer to correct incisor position. If late crowding has developed, it is often necessary to reduce the interproximal width of lower incisors before realigning them, so that the crowns do not tip labial into an obviously unstable position. Not only does this approach reduce the mesiodistal width of the incisors, decreasing the amount of space required for their alignment but also it flattens the contact areas, increasing the inherent stability of the arch in this region.

Spring Retainers

Spring retainers or spring aligners seem to offer the best of all worlds combining some of the principles of Hawley type retainers with those of the tooth positioners (Fig. 7.1A).

They utilize the same principles and procedures as those described for positioners, aligning the incisor teeth on a working model and

Figs 7.1A and B: Active retainers. **A.** Appliance; **B.** Spring retainer on a model.

fabricating an acrylic and wire spring to move the patient's incisors to that positions (Fig. 7.1B).

Many orthodontists use a spring retainer in conjunction with proximal reduction to correct tooth size discrepancies where an excess of mandibular tooth size exists. The proximal reduction ideally should be performed prior to the fabrication of a working model.

A continuous piece of 0.711 mm diameter wire is contoured to the labial and lingual surfaces of the incisors with vertical loops overlaying the buccal and lingual surfaces of the canines similar in design to the vertical loops of Hawley's appliance. Acrylic is added on the lingual and labial wire overlaying the four incisors and contoured to follow the incisal edges occlusally and the gingival contour apically. When placed in mouth, the retainer will 'spring' to engage slightly malpositioned teeth and move them into the alignment established on the working model. Because of the potential hazard of a patient swallowing or even aspirating a spring retainer, many orthodontists now use modified Hawley retainer. In this appliance, flanges extend lingually to the distal of the first and second molars, and incorporated an occlusal rest to prevent settling of the appliance. The flanges join the lingual clip via the 0.711 mm wire and thus do not interfere with the spring action of the appliance.

Removable Spring Retainers

Removable spring retainers can be used to correct rotations and buccolingual malpositions. But it sometimes fails to position incisors ideally no matter how well they are adjusted.

ACTIVATABLE RETENTION TECHNIQUE

Activatable retention technique is a complementary to orthodontic treatment. It should never be used to substitute an incomplete treatment. They have the capacity to be constructed as inactive retainers and in accordance with requirements of the corrected malocclusion. They may be activated in cases where there is a sporadic irregularity in some tooth or teeth.

TYPES OF ACTIVE RETAINERS

Upper Retainer

The activatable upper retainer is basically in the upper incisor area. It is built on the base of an acrylic palate, which supports a vestibular arch, four lingual springs for upper incisors and two or four clasps of Adams type (Figs 7.2A and B).

The vestibular arch is of 0.7 mm; caliber wire comes out from the interproximal space between the canines and the first premolars conforms to the gingival curve of the upper canine and comes down to the middle third of the vestibular side of upper canine.

The vestibular arch bends distally at the interproximal space between the upper lateral incisor and canine, reaching the distal arm of the vestibular loops. It recurves over itself and touching the afferent wire segment, runs toward mesial along the vestibular wall of the canine and upper incisors, which it touches.

The recurved portion of the wire passing in front of the upper canines has the effect of controlling the position of these teeth on the vestibular side.

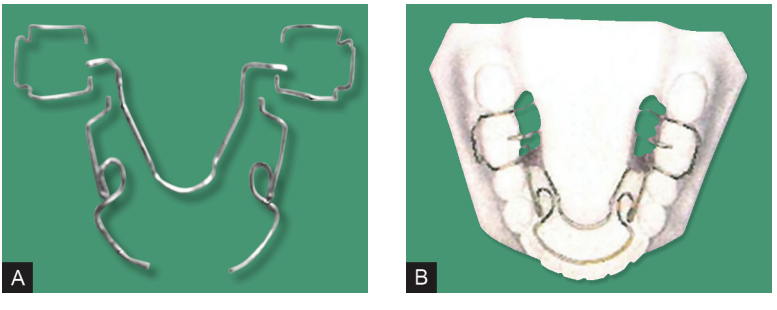
Figs 7.2A and B: Upper retainers. **A.** Metal parts making up the semiactive retainer; **B.** Occlusal view of the finished semiactive upper retainer.

On the lingual side, four lingual springs are made of 0.7 mm round wire. The springs are passively placed in contact with lingual wall of incisors, producing a passive retention effect and at the same time are activable. This has the advantage of recovering the small irregularities in the position that could appear in upper incisors. The Adams clasp consists of 0.7 mm wire.

The acrylic body is made as thin as possible for comfort and a hole is made in the middle part of the palate, at the level of canines that acts as a reference and serves to encourage the instructions, such as correct repositioning of the tongue, given to the patient in case it is deemed necessary.

Lower Retainer

The activatable mandibular retainer is made up of two small acrylic bodies that are to lingual of the first molars and support the ends of the wires that shape the devices. The central body made of 1.1 mm diameter wire, joining both sides of the retainer. The central body starts at the occlusal fossa of the lower molar where it acts as an occlusal stop. It has a bend toward gingival and descend along the lingual sides of molar and 2 mm below the gingival border, bends to the mesial and runs along the inner side 1.0 mm from the alveolar mucosa, passing to the opposite side, then circles under the lingual frenum, which it eludes with a 'U' bend and repeats the same course to the counter lateral molar. The appliance is retained by two Adams clasps that are made of 0.7 mm wire (Figs 7.3A and B).



Figs 7.3A and B: Lower retainers. **A.** Set of metal elements making up the semiactive lower retainer; **B.** Occlusal view of the finished semiactive lower retainer.

The activatable components are made of two arms whose ends are embedded in the acrylic bodies of the molars and are projected toward mesial, passing through the middle third of lingual side of the premolars and contacting them. When these arms reach the distal part of the canines, they recurve upon themselves and run toward distal at a distance of one premolar and all along the recurved stretch; both wires are in longitudinal contact.

In the interproximal space of both premolars, the wire descends toward gingiva and shaping the tooth in wide, round loop, ascends again toward the lingual side of the lower canine and in its middle third, bends in a sharp angle toward mesial to run in a harmonious curve along the lingual wall and above the cingulum of the lower canines and incisors.

It is easy to make and repair, and possesses no hygienic problem. Comfort of use makes it highly acceptable to patient.

Functional Appliances

8

ANDRESEN APPLIANCE

The principle action of these appliances is the dentoalveolar tooth movement particularly of the upper incisors, often with favorable change in the molar occlusion from class II to class I.

There are no specific requirements for retention following Andresen appliance therapy and there is no need to construct formal retainers. It is advisable, however to be cautious in the immediate post-treatment period. When satisfactory tooth movement has been achieved, it is wise to withdraw the appliance slowly over some months by asking the patient to reduce wear by degrees, finishing by wearing it only one or two nights per week. At this point the appliance can be finally abandoned and suitable records taken to monitor future changes (Fig. 8.1).

ACTIVATOR

Activator is the most widely used derivatives of the Andresen's original appliance. Its role is to correct the incisor overjet and overbite and the molar relationship during a period of active facial growth.

When the activator has been used alone then gradual reduction in the hours of wear is the first step toward dispensing with the appliance completely. If the occlusal change has been particularly rapid, it is wise to continue retention on the nights only basis until it is certain that the growth spurt is completed. It is also usual to remove the occlusal shelves at this stage so that the posterior teeth can achieve full intercuspation. When treatment is completed

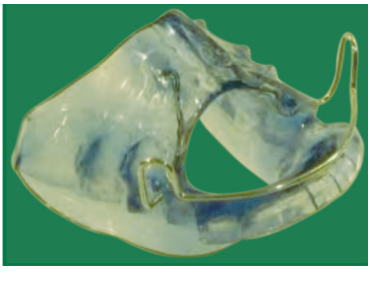


Fig. 8.1: Andresen appliance

with fixed appliances then the usual guidelines for post-treatment retention can be adherent to (Fig. 8.2).

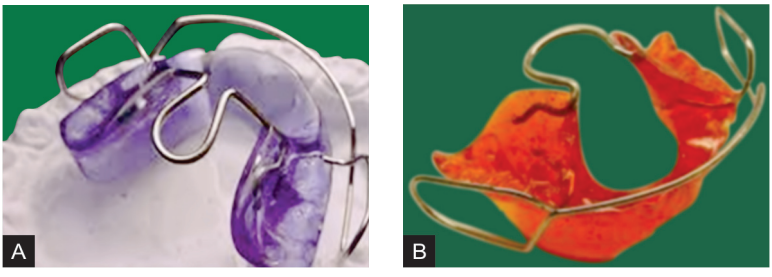
However, some class II or headgear force should again be maintained until the growth spurt has been passed. If there is concern that the lower labial segment has been proclined excessively, then it is possible to ease the lingual acrylic away from the lower incisor contact or indeed to remove this section completely.

A typical use for an activator as an active retainer would be a male adolescent patient who had slipped back 2–3 mm toward a class II relationship after early correction. If the patient is still growing actively, it may be possible to recover the proper occlusal position of the teeth. Differential anteroposterior growth is not necessary to correct a small occlusal discrepancy tooth movement is adequate, but some vertical growth is required to prevent downward and backward rotation of the mandible. For all practical purposes, this means that a functional appliance as an active retainer can be used in teenagers, but is of no values in adults. Stimulating skeletal growth with a device of this type simply does not happen in adults, at least to a clinically useful extent.

The use of an activator as an active retainer differs somewhat from its use to guide skeletal growth during the mixed dentition or when it is used as a pure retainer. In the latter circumstances, the object is to control growth and tooth movement is largely an undesirable side effect. In contrast, an activator as an active retainer is expected primarily to move teeth—no significant skeletal change is expected. An activator as an active retainer is not indicated if more than 3 mm of occlusal correction is sought and over this distance, tooth movement as a means of correction is a possibility. The correction is achieved by restraining the eruption of maxillary teeth posteriorly and directing the erupting mandibular teeth anteriorly.

The whole family of modified activators designed to produce tooth movement is most useful in this active retention mode, not in early mixed dentition treatment where tooth movement for the most part is undesirable. On the other hand, the more flexible a removable appliance becomes the less suited it is for the retention part of active

Fig. 8.2: Activator appliance



Figs 8.3A and B: Bionator. **A.** After application; **B.** Appliance.

retention and the more likely it would be to require replacement with another type of retainer when the occlusal relationship had been reestablished. An activator or bionator with an acrylic framework that contacts most teeth, therefore, is usually the best compromise when this type of active retention is needed.

BIONATOR APPLIANCE

Bionator appliance was developed in the 1950s by Balters, who lay considerable stress on the importance of the tongue in the development of open bites, and class II and class III malocclusions. It is a light appliance with minimum bulk and as it is relatively easy to speak with the appliance in the mouth, it can therefore be worn virtually full time. The retention phase usually requires the removal of all the occlusal shelves to allow full intercuspation of the posterior teeth and a reduction in the hours of wear (Figs 8.3A and B).

FUNCTIONAL REGULATOR

Functional regulator of Frankel is a flexible appliance, the design of which is based upon rather different principles to the rigid acrylic functional appliance. Its originator claims that it is an exercise appliance and that by retraining the facial muscles and the muscles of mastication to occupy new positions, the mandible and the maxilla will be influenced to grow into corrected positions (Fig. 8.4).

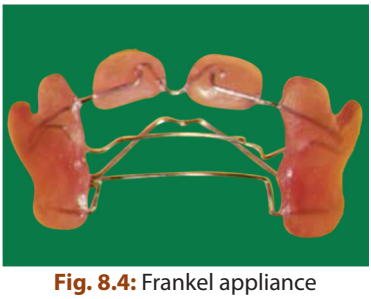


Fig. 8.4: Frankel appliance

It does not require any modification to enter a retention period. All that is required is for it to be worn for a reduced period of time. If this is the sole method of treatment, it may be necessary to maintain part-time wear until the maximum pubertal growth spurt has passed.

Frankel and Bionator type appliances have been used as dual-arch retainers to prevent anteroposterior relapse, but these are less predictable than single-arch retainers in maintaining intra-arch stability.

REMOVABLE PLASTIC HERBST RETAINER

Removable plastic Herbst retainer is full upper and lower plastic splints function as conventional single-arch retainers (Fig. 8.5A). At the same time, the removable splints are connected on each side by the telescoping Herbst mechanism, which acts as a dual arch anteroposterior retainer.

The feature of this retainer is the same as the Herbst appliance. Upper and lower plastic splints are fabricated over a supporting wire framework and connected by the Herbst mechanism (Fig. 8.5B). The principle difference between the retainer and the treatment appliance is that the retainer has full occlusal coverage on all teeth, including the upper incisors. This maintains tooth positions and prevents passive eruption.

If full-time wear is indicated, instruct the patient to remove the retainer twice daily for brushing, flossing and fluoride mouth rinsing. The appliance can be worn while eating, drinking, speaking or sleeping. Part-time wear can also be prescribed.

It can also be used to replace a fixed appliance as a finishing appliance if patient's compliance with class II elastics, headgear,

Figs 8.5A and B: Herbst retainer. **A.** Upper and lower occlusal splints; **B.** After application, connected by the Herbst mechanism.

diet or hygiene occasionally becomes unsatisfactory near the end of treatment. It can be used as a retreatment appliance in cases that have a tendency toward anteroposterior relapse. These patients can benefit from retreatment with this retainer. The removable plastic Herbst retainer may have an application as a postsurgical retainer in preventing skeletal relapse. Early clinical trials suggest that this appliance may be useful in protruding the lower jaw to maintain an airway in patients who suffer from episodes of obstructive sleep apnea. A form of the appliance has been used as an anterior repositioning splint for treatment of temporomandibular joint disorder.

The effectiveness of removable plastic Herbst retainer as a retreatment or finishing appliance in promoting skeletal changes is probably limited to patients who have the potential to adapt to orthopedic changes. Such adaptive ability can decrease with advancing age. In the absence of this potential, changes resulting from this appliance are probably dental rather than skeletal.

Fixed Retainers

9

INTRODUCTION

The acid etch technique heralded a new era in dentistry, however, it was some time before acid etching of enamel was applied in orthodontics. The bonded fixed retainers consist of a length of orthodontic wire bonded to the teeth with acid etch retained composite.

BONDED RETAINERS

There is much variation in the design of bonded fixed retainers. These include different wire types with differing diameters, different composites, the use of mesh pads, intracoronal wire ligation with composite placed over the wires, use of mesh alone with composite and the use of resin fiberglass strips.

Types

Early bonded fixed retainers were made with plain, round or rectangular orthodontic wire, but Zachrisson proposed the potential advantages of the use of multi-stranded wire for their construction. Artun and Zachrisson first described the clinical technique for the use of a multi-strand wire canine-to-canine bonded fixed retainer. In this retainer, the wire was bonded to the canine teeth only. In 1983, Zachrisson reported the use of multi-stranded wire in a bonded fixed retainer in which the wire was bonded to all the teeth, in the labial segment.

Bonded fixed retainers using multi-strand wires can be further divided into two different types:

1. Canine-to-canine bonded fixed retainer.
2. Flexible wire bonded fixed retainer.

In the former, a relatively rigid, large diameter multi-strand wire, usually 0.8128 mm is bonded to the canines only. In the latter type,

a smaller diameter multi-strand wire, usually 0.4445 mm or 0.5461 mm is bonded to each tooth in the labial segment. In this situation, advantage is taken of the flexibility of this wire, in addition to the surface roughness of the wire.

THIRD-GENERATION MANDIBULAR BONDED LINGUAL 3–3 RETAINER

Since their introduction in 1977, direct bonded 3–3 retainers have been used to improve the long-term stability of orthodontic treatment results. Because of technological improvements, the design of the retainer bar has changed over the years.

The first-generation retainer was a plain, round 0.8128–0.9144 mm wire with a loop at each end. In 1983, this design was replaced by a twisted, 3-stranded 0.8128 mm wire. The second-generation retainer did not have terminal loops, since adequate retention was provided by the wire spirals and was thus, neater and easier to fit.

The introduction of miniature sandblaster enables the design of the third-generation bonded retainer (Figs 9.1 and 9.2). It is consisted

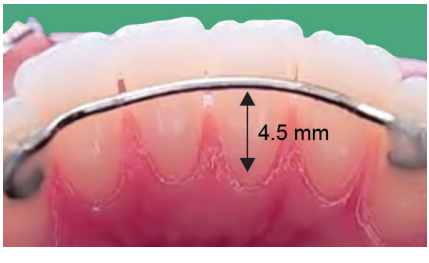


Fig. 9.1: Third-generation mandibular bonded lingual 3–3 retainer (SB, sandblasted end)

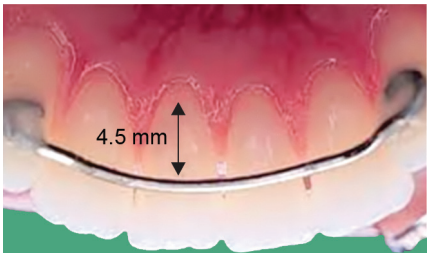


Fig. 9.2: Third-generation mandibular bonded lingual 3–3 retainer (cemented in lower arch)

of a plain, round stainless steel wire of 0.762–0.8128 mm in diameter, which is sandblasted at both ends (area to be bonded with composite). Sandblasting provide a quick, inexpensive and simple method of increasing the micromechanical retention surface.

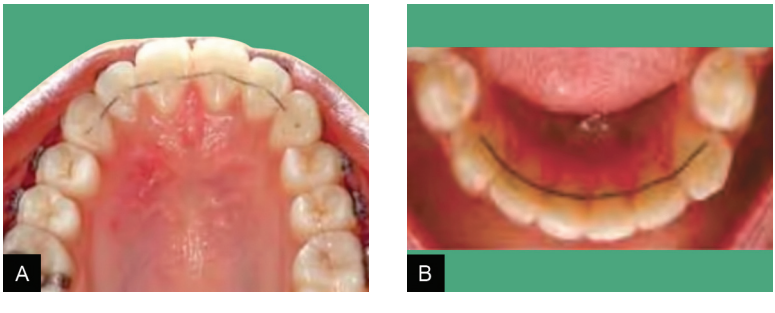
Bonded Lingual Retainer

The multi-stranded flexible wire (0.381–0.508 mm), was useful to prevent space reopening in different clinical situations. The twist in the spiral wire gave undercut areas for mechanical retention and the flexibility of the resilient wire was thought to allow physiologic movement, during the period of retention.

The flexible spiral wire retainers (Figs 9.3A and B) were found to be excellent in the following situations:

1. Closed median diastemas.
2. Spaced anterior teeth.
3. Adult cases with potential postorthodontic tooth migration.
4. Accidental loss of maxillary incisors, requiring the closure and retention of large anterior spaces.
5. Space reopening, following mandibular incisor extractions.
6. Severely rotated maxillary incisors.
7. Palatally impacted canines.

The retainer is prefabricated of two mesh-backed attachment bases, joined by a lingual bar with interbase lengths in four sizes —20, 22, 24 and 26 mm. The attachment bases are constructed of a stainless steel shield on a welded wire mesh and are joined to the lingual bar with silver solder. The lingual bar may be constructed of gold, brass or stainless steel, with a diameter range of 0.635–0.9144 mm



Figs 9.3A and B: Bonded lingual retainer. **A.** Upper arch; **B.** Lower arch.

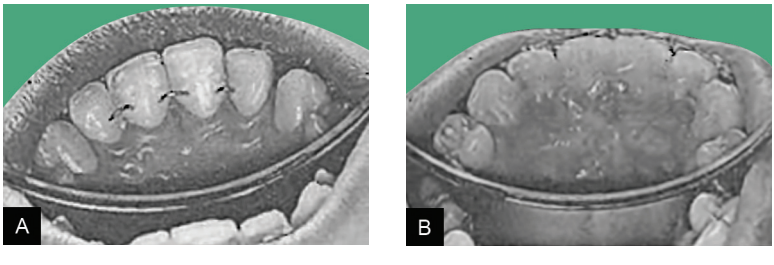
small gauge wire is preferable. The only drawback of using brass wire is that, it may tarnish in patients with poor hygiene. The only drawback to stainless steel is that, it takes more time and is more difficulty to adjust. Both were used successfully on patients in this study. Gold wire is probably the ideal wire for this retainer, since it is strong, tarnish resistant, easy to adjust and a smaller, more comfortable wire can be used. It was found that 0.8128 mm brass wire can resist 40 ounces of pulling force without distortion, while 0.7112 mm gold wire can resist 52 ounces. In normal circumstances, 40 ounces should be strong enough to retain mandibular incisors and resist the force of mastication.

Retentive Staples

In this study, a staple (Figs 9.4A and B) is used to retain the teeth after they have been moved together by orthodontic means. Cavity is drilled in the proximal of the teeth (lingual or palatal) that is to be used in the retention. It is formed by drilling a retention hole, using a pin drill (2 mm in depth). A soft 0.6096 mm stainless steel wire in the shape of a staple is placed into the two holes and cemented with composite. This composite will both cement and cover the metal color of the wire. Retentive staples are so placed that they will not interfere with occlusal relations.

Resin Fiberglass Bonded Retainer

Three major problems exist with most bonded cuspid-to-cuspid retainers—holding the lingual arch in position during bonding, adapting the arch to the contours of the teeth and repairing a broken arch in the mouth. The author developed a direct technique that solves these



Figs 9.4A and B: Retentive staples on upper arch. **A.** Before cementing; **B.** After cementing with composite.

Fig. 9.5: Resin fiberglass retainer on lower arch

problems and takes 20 minutes or less, with no previsit preparation. This system uses glass fibers from woven fiberglass fabric (Fig. 9.5). These fibers are separated into 6 inch strips, sterilized with dry heat and kept in inventory. The fiberglass strips are soaked in composite and bonded to acid etched enamel. Although this technique has the advantage of reducing the bulk of the retainer, it has the disadvantage of creating a rigid splint, which limits physiologic tooth movement and contributes to a higher failure rate.

Indications for Bonded Retainers

Bonded retainers are considered the following to be indications for placement of a bonded canine-to-canine retainer:

1. Severe pretreatment of the lower incisor crowding or rotation.
2. Deliberate alteration in the lower intercanine width.
3. Following advancement of the lower incisors during active treatment.
4. After non-extraction treatment in mildly crowded cases.
5. Following correction of deep overbite.

The main indications for the canine-to-canine retainer are related to alteration of the anteroposterior or lateral position of the lower labial segment during treatment.

Fixed orthodontic retainers are normally used in situations where intra-arch instability is anticipated and prolonged retention is planned. There are three major indications.

Maintenance of Lower Incisor Position During Late Growth

The major cause of lower incisor crowding in the late teen years is late growth of the mandible in the normal growth pattern in both patients who have undergone orthodontic treatment and those who have not relapse into crowding, is almost, always accompanied by

lingual tipping of the central and lateral incisors, in response to the pattern of growth. An excellent retainer to hold these teeth in alignment is a fixed lingual bar, attached only to the canines (or to canines and first premolars) and resting against the flat lingual surface of the lower incisors above the cingulum. This prevents the incisors from moving lingually and is also reasonably effective in maintaining correction of rotations in the incisor segment.

A fixed lingual canine-to-canine retainer can be fabricated with bands on the canines or can be bonded to the lingual surface. Since the labial part of a band, tends to trap plaque against the cervical part of the labial surface, predisposing this area to decalcification and is also unsightly, a bonded canine-to-canine retainer is preferred.

Diastema Maintenance

A second indication for a fixed retainer is a situation, where teeth must be permanently or semi-permanently bonded together, to maintain the closure of a space between them. This is encountered most commonly, when a diastema between maxillary central incisors has been closed. Even if a frenectomy has been carried out, there is a tendency for a small space to open up between the upper central incisors. Since this is unsightly, prolonged or permanent retention is usually needed.

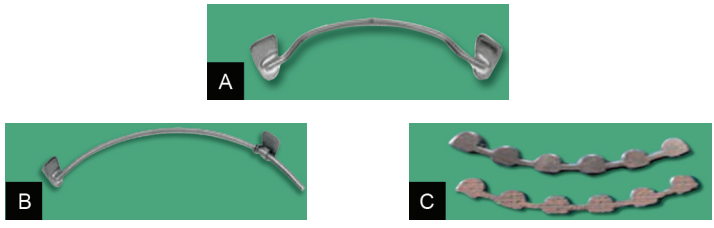
Maintenance of Pontic Space

A fixed retainer is also the best choice to maintain a space, where a bridge pontic will eventually be placed. Using a fixed retainer for a few months reduces mobility of the teeth and often makes it easier, to place the fixed bridge that will serve among other functions, as a permanent orthodontic retainer. If further periodontal therapy is needed after the teeth have been positioned, several months or even years can pass before a bridge is placed and a fixed retainer is definitely required.

PREFABRICATED RETAINER (Figs 9.6A to C)

Techniques for Construction of Bonded Retainers

Construction of a bonded fixed retainer might appear to be simple, but if good long-term success is to be ensured, meticulous attention



Figs 9.6A to C: Retainers. **A.** Prefabricated retainer; **B.** Adjustable lingual retainer; **C.** Modified retainer.

to detail is required. There are two techniques that are employed to construct the bonded retainers; direct and indirect techniques (Figs 9.7 to 9.11A to D).

Indirect Technique

The use of an indirect technique (refer Fig. 9.7) has been described to simplify the clinical procedure. The wire is prepared on the model, an inlay wax placed in the sites for the composite. A silicone impression material is placed over this and allowed to set. The wax is removed with boiling water. The teeth are prepared in the usual way and composite is placed in the voids left by the wax. The impression is completed with the retainer wire and composite is then placed over the teeth and held firmly in position, until the composite has set.

This indirect technique can be modified by placing composite directly on the model in place of the wax, allowing the composite to set and then covering this with a vacuum-formed plastic sheet for subsequent location of the retainer in the mouth. In this technique, it is an unfilled resin-bonding agent that is then used to bond the retainer to the enamel.

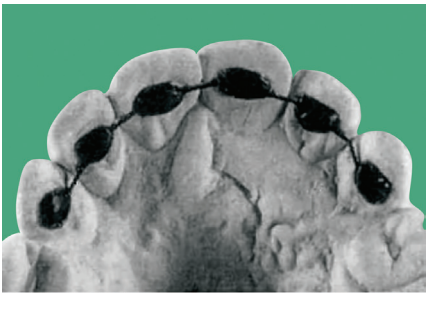
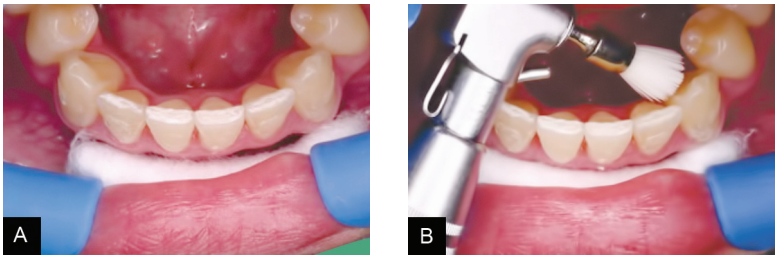


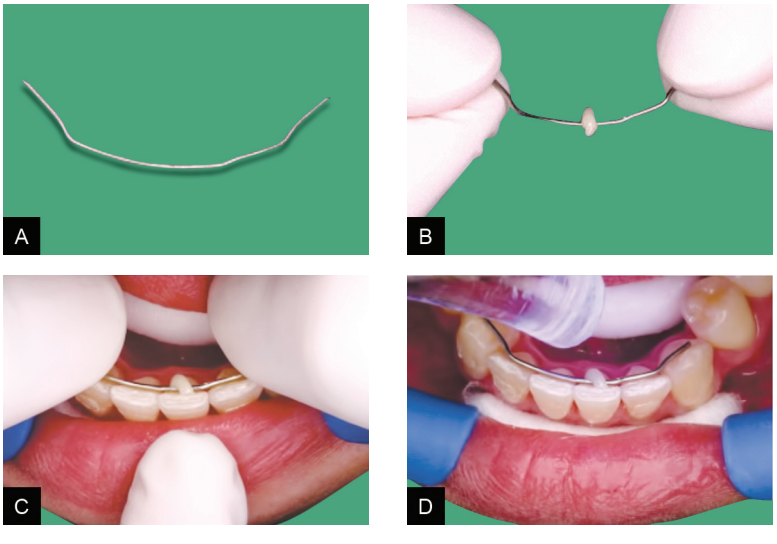
Fig. 9.7: Indirect technique, wire hold by inlay wax on upper model

Direct Technique

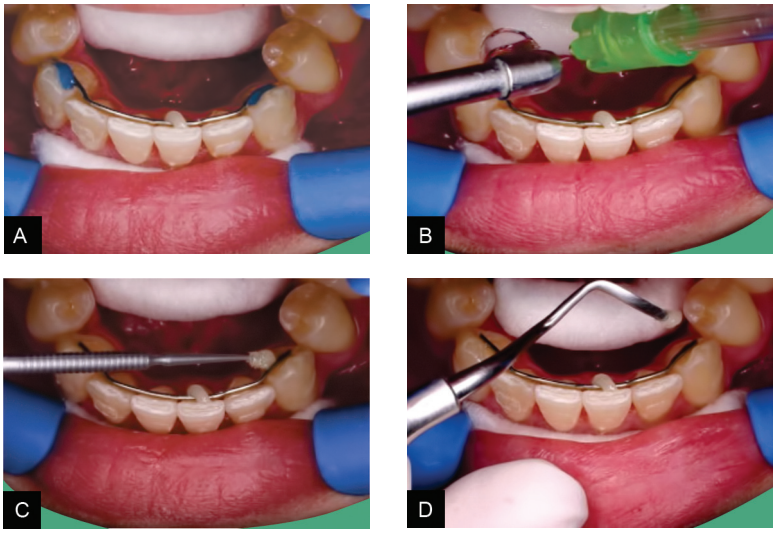
The direct technique requires a length of wire to be prefabricated to accurately fit a recent cast. Loops are not required at the ends of the wire. The adaptation of the wire is checked clinically to ensure



Figs 9.8A and B: Initial procedures. **A.** Clinical aspect of the adequate alignment of the teeth after removal of the fixed appliance; **B.** Brushing teeth before bonding.

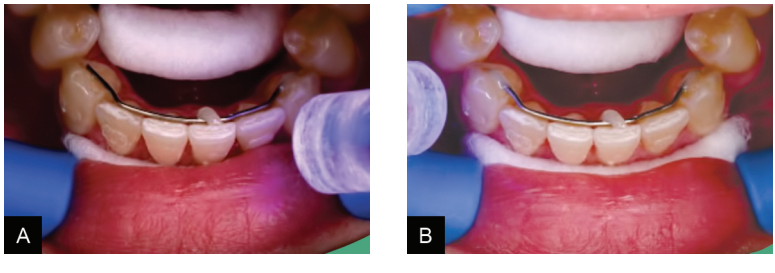


Figs 9.9A to D: Lingual retainer adaptation and positioning. **A.** Lingual retainer fabricated from 0.7-mm stainless steel wire directly adjusts in patient's mouth; **B.** Composite resin increment placed on the stainless steel wire; **C.** Checking position of the lingual retainer and resin increment placed on the lingual and incisal surfaces of lower left central incisor without previous acid etching; **D.** Light curing of the composite resin increment placed for holding the wire in position.



Figs 9.10A to D: Lingual retainer fixation: **A.** Acid etching of the lingual surface of the lower canines; **B.** Washing and drying of the acid etched surfaces; **C.** Application of the adhesive system on the acid etched surfaces; **D.** Placement of a composite resin increment on the left canine for definite bonding of the lingual retainer.

that it locates passively, against all tooth surfaces to be retained. Inadvertent activation of the multi-strand wire is a major concern and is to be avoided. The teeth are subsequently pumiced and acid etched as for direct bonding of orthodontic attachments. The wire is then accurately located on the teeth. The wire is held in that position by means of dental floss, orthodontic elastics, wire ligatures, wires



Figs 9.11A and B: Completion of lingual retainer fixation. **A.** Light curing of the composite resin on the left canine; **B.** Light curing of the composite resin on the right canine.

Figs 9.11C and D: Completion of lingual retainer fixation (Contd...). **C.** Removal of the fixation resin increment using an explorer; **D.** Aspect of the fixation resin increment after removal. Note that the increment detached completely from tooth surface.

tack welded to the retainer wire, localizing devices or fingers. The composite can be shaped with an instrument dipped in unfilled resin or alcohol, to produce the desired contour.

IN VIVO STUDIES OF BONDED RETAINERS

There are few reports in the literature on the long-term clinical performance of bonded retainers. They will be considered under three headings: reports on failure rate, failure type and reports on hygiene effect.

Failure Rates

Failure rates for bonded retainers are reported to range from 10.3% to 47.0%. The failure rates are approximately twice as greater in maxilla as the mandible and this is most likely because of occlusal factors. When placing maxillary retainers, care must be taken to ensure the retainer is free from occlusal trauma, to reduce the likelihood of failure.

Failure Type

Detachment at the wire/composite interface, is the failure type most commonly observed. Both placements of insufficient adhesive and material loss due to abrasion have been implicated in the detachment of the wire, from the surface of the composite. Abrasive wear of the composite has been reported in up to 62% of subjects in mandibular, as well as maxillary retainers. The abrasion of mandibular retainers

has been attributed to mechanical forces such as tooth brushing and chewing. With regard to the amount of adhesive used, abrasion resistance should be taken into consideration and the use of composites with greater abrasion resistance, may result in a decreased observed failure rate.

Hygiene Status and Bonded Retainers

Bonded fixed retention is mechanically satisfactory method of long-term retention. If these retainers are to be clinically acceptable for long-term retention, it is important that there are no detrimental effects on dental health.

Five studies have reported on the hygiene effects of bonded fixed retainers. The observation periods of these studies vary considerably. The shortest observation period is 4 months, whereas the longest observation in any individual subject may be up to 103 months.

None of the reports found any evidence of increased periodontal disease or enamel decalcification, in relation to lingual bonded retainers. There was no evidence of greater plaque deposits on multi-strand wire, when compared with round wire. Two cases have been reported with surface enamel demineralization, after 2 years of using labial bonded retainers, in the buccal segments.

CONCLUSION

In orthodontics, the patient may feel the treatment is complete when the appliances are removed. But this is absolutely not true. Orthodontic control on tooth position and occlusal relationships must be withdrawn gradually, not abruptly, if excellent long-term results are to be obtained. This is because, orthodontic treatment results are potentially unstable and therefore retention is necessary.

In reality, retention should be the least troublesome aspect of orthodontics, because there is simply not much to do. All that need to be done is just a simple appliance to hold the teeth in position, until the surrounding tissues have adapted to the new position of the teeth.

There are two most important factors that will affect retention: responsibility and duration. The patient must have the responsibility to maintain the retention appliance for good final result. The patient must wear the appliance as prescribed, maintain the hygiene of the appliance and oral surrounding and maintain follow-up appointment

with the orthodontist. The consequences of non-compliance is simply annoying, both to the orthodontist and the patient. Duration of retention is also very important. The duration is according to the severity of the pretreatment irregularities.

The use of various types of retainers is usually based on cases that are going to be solved and the knowledge of the operator on the available retainers. Each type of retainer is usually suitable for various cases; from easy to most complicated one.

Removable retainer has many advantages like it is cheaper, easy to handle—by patients and operators. In addition to that, removable retainer is also more hygienic in a sense that it is easier to clean. Despite of this, the removable retainer has its own disadvantages. Patient's poor compliance may become the major reason for relapse to occur. On the other hand, a removable retainer will make the patient comfortable and the result achieved at the end of treatment will be most satisfactory, if patient gives full cooperation.

On the contrary, the major advantage provided by fixed retainer is, it is compliance free—except with regard to oral hygiene procedure. Fixed retainers also provide a good source of retention with less bulkiness, as compared to the removable retainer. Despite of this, it has a lot of downturn too. Two of its disadvantages are: its placement procedure is very technique sensitive and time consuming. In addition to that, plaque accumulation due to patient's difficulty to floss, is also a major disadvantage.

From the information that we gathered from this literature review, we conclude that the removable retainers are more suitable in certain cases, where limited retention is required and it is best accepted in the maxillary arch. However, in cases where permanent or prolonged retention is a must, a fixed retainer is still the best choice.

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