

# Retention—The Stepchild of Orthodontia\*

GEORGE W. HAHN, D.D.S., F.A.C.D.  
*Berkeley, California*

SINCE the introduction of the pin and tube appliance by Dr. Angle in 1908, which was introduced primarily as a working retainer, the mechanics of orthodontic treatment have been subject to constant scrutiny, revision and improvement. Etiology and diagnosis as well have progressed far beyond the concepts of the earlier students. So great have these changes been that the present day methods of treatment and diagnosis would be scarcely recognizable by such men as Kingsley, Farrar, Guilford, or their contemporaries. During this time retention has made but one change of note. The transition from the use of mechanical devices which were designed to hold the teeth immovable in their new positions to those which permit "freedom of movement in every direction save that toward which the teeth tend to return." This is a complete reversal from the earlier teachings as indicated by a quotation from a paper read before the Ninth International Medical Congress in 1887 by Dr. Angle—"A retaining appliance should hold the teeth so firmly that there will be no movement to disturb or in any way interfere with the new bone formation. Absolute rest is essential to the most speedy and satisfactory results."

The newer concept of retention was evolved the hard way, that is by clinical evidence, the result of trial and error, and in all clinical evidence in the history of orthodontia this one basic fact stands out: "That irrespective of the length of time a tooth is held in its new position by any means whatsoever, it will upon release seek a position where it is in balance with the forces that act upon the denture—whether these forces are for good or evil is immaterial, the greatest of these forces is the force of occlusion." Mershon once said "You can move teeth to where you think they belong—Nature will move them to where they will best adapt themselves to the rest of the organism."

No matter how, when, or where teeth are moved during treatment, the basic principles of retention are the same and can be stated very briefly. "To antagonize the movement of the teeth in the direction of their tendencies, and to allow the teeth freedom of movement in every direction save that toward which they tend to return." (Angle)

## FAILURES IN RETENTION

Before proceeding further let us review some of the causes of failure in retention, or as more commonly called, relapses in orthodontic treatment.

1. Failure to remove the cause of the malocclusion.
2. Incorrect diagnosis and failure to properly plan treatment.

---

\* Read before the Northern Section of the Pacific Coast Society of Orthodontists, Victoria, B.C., June 1943.

3. Lack of normal cuspal interdigitation.
4. Teeth off the ridge laterally—over expansion.
5. Teeth off the ridge anteriorly too much forward movement.
6. Incorrect arch form.
7. Incorrect apical inclination.
8. Winking at rotations. (Failure to over-rotate or to complete rotations)
9. Incorrect curve of Spee.
10. Lack of balanced amount of tooth structure in the four quadrants of the dental apparatus.
11. Failure to restore normal tissue tone through exercise.

#### *Failure to Remove Cause of Malocclusion*

Failure to remove the cause is in many instances especially in young children the prime reason for relapse in treatment. The obscurity of many of the etiological factors is known to all of you, but the orthodontists generally are negligent in their efforts in tracing out the causes of the malocclusion and especially so in educating both patients and parents in their responsibility for help in the correction of even the most obvious habits such as thumb-sucking, tongue and swallowing habits and detrimental sleeping positions. In the matter of patient education we would do well to take a lesson from Dr. Spencer Atkinson who keeps a small camera focused on his patients while in the chair and produces for them visual evidence of their leaning habits.

#### *Incorrect Diagnosis*

All too often an orthodontic diagnosis is a sketchy affair consisting of a glance at a set of X-Rays and a casual survey of the plaster models of the teeth. A written case analysis together with a complete outline of the treatment to be initiated and followed will often reveal conditions that otherwise might be easily overlooked. Rarely is sufficient consideration given to the hereditary, environmental and psychological factors that affect not only the face and jaws, but the child's entire physical development. Success in orthodontic treatment should be measured by the number of cases successfully retained rather than by the number of names that appear in the appointment book. In order to improve this ratio the following axiom should become a part of our philosophy, *No case should be considered for treatment unless and until a satisfactory method of retention can be provided for it.*

#### *Cuspal Interdigitation*

For years many of us felt that if teeth were placed in an approximate position the force of occlusion would cause them to settle into a balanced position. This may be true in some mixed denture cases where growth and eruptive force is still active, but with the complete eruption of the teeth these forces are lost and we cannot exert too much care in the final finishing of our cases and the positioning of the teeth in occlusion. None can deny that often there is a great temptation to remove the active appliances before the teeth have been thoroughly established in occlusion. In Dr. Angle's 7th Edition you will find this paragraph in the chapter on Retention. "It cannot

be too strongly insisted upon that the permanency of the teeth in their new positions cannot be hoped for regardless of the length of time the retaining devices have been worn unless such occlusion has been established as will enable the inclined planes of the cusps to ultimately act in perfect harmony for mutual support which also means perfect harmony as to sizes and relations of dental arches."

#### *Over Expansion and Forward Movement*

Always in orthodontic treatment there has been a tendency to over expansion of the buccal teeth and forward movement of the anterior teeth in both arches. Previous to the general adoption by the profession of stable or bracket type of appliances this tendency resulted only in a tipping of these teeth. With the introduction of the pin and tube mechanism, followed by its more refined successors which controlled root as well as crown movement we find that in many cases the teeth are now moved bodily off of their basal bones. Early theories of bone growth led clinicians to believe that growth of the body of the maxilla and mandible would follow such tooth movement. So far no evidence has been presented to support this theory. In fact clinical evidence points to quite the contrary, therefore we have the incompatible situation in which the teeth and alveolar processes are found laterally and forward with little or no supporting bone beneath. This condition recognized earlier by Case and Grieve and later given prominence by Tweed has resulted in the employment of the most drastic methods ever used in orthodontic treatment to keep the teeth back in the skull and over the basal bones. It is my belief that one of the most common causes of relapse is the forcing of the teeth to a position where they lack the necessary bony support. There is plenty of clinical evidence to support the statement that teeth and sometimes alveolar process can be moved laterally but the old theory that this will ultimately lead to the lateral growth of the body of the maxilla and mandible is no longer tenable.

#### *Arch Form*

This naturally leads us into a discussion of arch form. Such discussion per se is not within the limits of this paper. It is sufficient to say that the methods used in the past as well as those in common use today are mostly arbitrarily set up on the basis of tooth size or are arrived at by the individual operator as a result of experience and judgment. Until we give greater consideration to individual type and hereditary characteristics and endeavor to provide greater harmony between arch form and the physical architectural pattern of the individual we will be faced with failures after treatment. It is not possible to fit a square peg in a round hole.

#### *Axial Inclination*

The teeth of man which depend upon mutual proximal support for maintenance of their positions are usually found to have a forward inclination when the teeth are in normal occlusion. This is not true in some of the lower animals which show a diastema and in which it is necessary that the tooth immediately distal to the diastema incline distally in order to prevent

the forward migration of the dental units immediately posterior to it. This is well demonstrated in the rodents. Orthodontic mechanics has not as yet progressed to the point where we can move teeth bodily, distally and at the same time maintain their normal mesial inclination. In our urge to get and to keep the teeth back in the skull we have increasingly made full use of torque force which immediately throws the roots forward and destroys that which is of great value in maintaining balance during function. This eventually leads to the collapse of the structure we have so painstakingly built.

#### *Rotations*

In all of the seven movements possible with an individual tooth that of rotation is the most difficult to maintain. The reason for this lies in the fact that in rotation all of the periodontal fibres from the gingival border to the apex of the root are disturbed and it is the attempt of these fibres to retain their former status that causes the tooth to relapse toward its original position. This tendency becomes more pronounced with the degree of rotation necessary and with the age of the patient. This tendency can be overcome first by slightly over-rotating all teeth in which such movement is indicated, thus permitting of a slight relapse, and secondly, by means of a retainer that offers resistance both mesially and distally. The reason for this is obvious. If a tooth is rotated around an axis that passes through the center of the tooth, or the bracket attachment, and is retained only by a spur soldered on the mesio-buccal angle with the free end contacting the disto-buccal angle of the tooth anterior to it—the rotation axis will shift and the tooth will rotate around the new point of contact. However, if a second spur is placed on the disto-lingual of the band, its free end making contact with the mesio-lingual angle of the tooth distal, maintenance of the rotated tooth is assured, at least during the retention period.

#### *Curve of Spee and Occlusal Plane*

Nothing is more necessary to the normal functioning of the human denture in lateral excursion than a curve of Spee harmonious in form with the architectural pattern of the "mill." It is generally thought that the curve of Spee should be greater in dentures with long cusps and deep over-bites and less deep in those cases showing flat cusps and shallow over-bites. As this curve bears a very definite relation to the steepness of the occlusal plane as well as to the condylar path it is difficult without the use of a mechanical articulator to determine the radius of the curve. For a more complete description of this I suggest that you study the exceedingly technical and excellent article by Harvey Stallard, published in the March 1937 issue of the *Journal* of the A.D.A.

#### *Mesio-distal Diameters of Teeth*

It would seem quite obvious that if we are to have balance in occlusion we must have a proportionate amount of tooth substance in the opposing arches as well as an equal amount in the two lateral halves of the same arch, especially mesio-distally. How frequently do we find this condition existing in the mouths of our patients? A recent survey was made by Dr. Murray

Ballard of Chico, California and the following data was taken from his findings.

Out of 500 cases measured, 408 or 81.6% showed a variation of .5 m.m. or more in the length of the lateral halves of the arches—while only 72 cases showed a balance between the two lateral segments of the same arch. In cases showing such variation one of the following methods of treatment is indicated.

1. Occlusal and/or proximal grinding.
2. Rebuilding through restorations.
3. Permit of slight rotations or overlapping of anterior teeth.
4. In extreme cases the full restoration of the crown of the tooth.

#### *Restoration of Normal Tissue Tone*

In any malocclusion, especially those of long standing, the soft tissues, the muscles of mastication and expression, and the bone itself have accommodated themselves to the deformity. We anticipate that with the restoration of normal occlusion and a reasonable period of mechanical retention that these tissues will reorganize themselves and eventually function in harmony with the changed dentition.

This may eventually take place but it would seem good practice to stimulate this by muscle exercise. For further information on this subject I refer you to the work of Dr. Alfred P. Rogers of Boston than whom there is no better authority.

Calvin Case in his summary of the principles of retention gives the following as the first consideration: "Teeth that are moved by orthodontic processes from one relative position to another are for a considerable time—often for years—subjected to the physical forces of surrounding tissues which tend to move them back toward the irregular positions they formerly occupied."

And lastly in order that you may not feel too keenly that failures are always the fault of the orthodontist, may I quote from Oppenheim who speaks of retention as a period of repair—"As we do not know anything about the amount required and the time necessary for the reparative processes which are quite different in different individuals we can in no case of finished treatment say whether there will be a permanent success or whether a relapse is to be expected."

#### MECHANICAL RETAINING APPLIANCES

As the period of active treatment has usually involved the use of bands and arches together with their auxiliary attachments all of which we look at with a caressing eye but which to the patient are an abomination, it is advisable to plan our retention in such manner that any mechanical devices used will be as inconspicuous as possible. However, we should be mindful of the fact that in no case should the mechanical efficiency of the retaining appliance be sacrificed for esthetics. The conglomeration of devices for retention which have graced the pages of the text books on orthodontia have gradually evolved into the following basic types:

Bands and Spurs.

Cuspid to cuspid and molar to molar lingual wires.  
Plate Retainers.  
Extra oral retention.

### *Bands and Spurs*

Usually the use of bands or bands and spurs can be confined to those teeth that have required extreme rotation or elongation and to those devices that require a heavy wire attached at each end such as cuspid to cuspid or molar to molar lingual retainers. If it is planned to use bands in retention and those used in treatment have been injured in removing or have become ragged as they sometimes do through use, they should be replaced with bands of new material.

### *Cuspid to Cuspid Retainer*

The cuspid to cuspid retainer although losing favor in the past few years is, in conjunction with a lower plate, one of the most valuable methods of retaining the lower anterior teeth in position. In addition to maintaining these teeth that are most frequently subject to relapse it aids materially in keeping the lower plate from being forced upward by the action of the tongue.

### *Molar to Molar Retainer*

The molar to molar lingual retainer especially in the lower is used extensively by some of our best clinicians. It has the advantage of not being subject to removal and loss or breakage by the patient, yet it, like the cuspid to cuspid retainer fails to fulfill one of the basic requirements of a retaining appliance in that it does not permit the teeth to which it is attached, freedom of movement; furthermore in those cases requiring long periods of retention where the patient is seen only at rare intervals there is always the possibility that one or both of the bands will loosen. As you know, this is often followed by decalcification of the enamel; an embarrassing situation. If the heavy wires necessarily used in the construction of this type of retainer are to be in contact with the teeth for long periods of time they should be made of nickel silver for although there may be surface discoloration of the teeth under them there will seldom be decalcification of the tooth structure, a fact which is not true of the precious metal alloys.

### *Removable Plate Retainers*

Probably the most universally used of all retainers are the removable plate retainers. With the addition of wires and clasps, slots and grooves, they can be made to retain practically all orthodontic corrections. They fulfill perfectly the basic requirement of a retaining appliance in that they allow freedom of movement of the teeth, and in growing patients permit of continued development of the arches. Their one disadvantage is that they are subject to removal by the patient with the consequent possibility of loss and breakage. This can be almost entirely overcome by insisting that they be removed only for cleaning. The practice of some men in permitting the patient to remove them while eating should be discouraged. If properly

made and fitted, the patient after one or two meals will scarcely realize that they are in the mouth. As the change from the use of active appliances to the period of retention is one of the most hazardous in orthodontic treatment it is good policy to have one or both of the parents present at the time the retainers are placed in order that they may understand the function and care of the retaining appliance. This may be followed by a letter such as the following which should leave no doubt as to where lies the responsibility for loss or breakage.

June 14, 1940

*Mr. Russel R. Jones*  
*874 Hilldale Avenue*  
*Berkeley, California*

MY DEAR MR. JONES:

The retaining appliance placed in William's mouth recently, is designed to hold the teeth in their present relationship and prevent them from drifting back toward their former positions. In order to be effective however, this must be worn continuously unless William is otherwise instructed. It should be removed only for cleaning and while the teeth are being brushed, as there is always the possibility that it may be lost or broken if left out of the mouth.

The habit of continually dropping the retainer with the tongue or working it up and down in the mouth should be guarded against as this may cause grooves to be worn in the enamel of the teeth as well as to so weaken the wires that damage may result.

If these precautions are observed, it is not likely that there will be any loss or breakage; however, should either occur, a minimum charge to cover replacement costs will be necessary.

Very truly yours,

The new acrylic resins are ideal substances from which to make retainers. Any assistant with sufficient intelligence to be employed in an orthodontist's office can learn in a few weeks or days the technic of waxing and processing retainers made from this material. In the processing of this material the dirt and odor which accompanies the vulcanizing of rubber is entirely eliminated. The only equipment necessary is a flask, a small press and a cooking pot. The technic is so simple that if the bands are removed and the impression taken before nine in the morning the retainer can be placed before four in the afternoon of the same day. In order to be of least discomfort to the patient these retainers should be exceedingly thin not to exceed .035 thousands of an inch in thickness, or about that of two layers of 28 gauge wax. If necessary the lower retainer can be reinforced with a section of .022 stainless steel wire. Acrylic retainers should be processed between two layers of tinfoil or cellophane which eliminates the necessity of polishing and gives a surface when wet similar to that of the tissues of the mouth. By making them thin, the impression of the rugae can be carried through on to the palatal surface, this is a very definite aid in phonation. If made in this manner they will be maintained in position by atmospheric pressure and the attraction between the moisture on the surface of the retainer and that on the palatal surface of the mouth. It is only when they are made too heavy and bulky that it is necessary to add clasps to aid in their retention.

In the usual design of upper plate retainers there are two common procedures in general use that are contra-indicated.

The first is found in those cases where a labial wire is used to prevent the anterior teeth from moving forward. It is common practice to bring this wire from the plate through the inter-proximal space distal to the cuspid. Just why this forward pressure should be applied distal to the cuspid when it is one of the most difficult teeth to move distally is hard to understand. It would seem much better mechanics to bring the wire through the inter-proximal space between the lateral and cuspid and if necessary in order to insure against the forward migration of the cuspid, solder a short section to the labial wire in the region of the lateral incisor and contour it over the labial of the cuspid.

Secondly, where plates are used in the retention of cases showing forward displacement of the maxillary teeth it is common practice to fit these plates snugly around the lingual surfaces of the anterior teeth. After the effort involved in retracting these teeth why place a retainer against their lingual surfaces that exerts a forward pressure with every movement of the tongue. In addition the concave lingual surface of the central and lateral incisors is an ideal place to trap food and debris which is seldom reached with the tooth-brush. Except in those cases showing severe rotations the anterior border of the retainer should be finished off in an irregular line from cuspid across to cuspid.

Frequently in mixed denture cases where a plate retainer has been in place for a considerable time there will be a tendency to lateral growth of the maxillary arch causing the bicuspid to erupt in buccal occlusion. This can be controlled by cutting the retainer away from the lingual surfaces of the deciduous molars as soon as these teeth show signs of loosening.

A simple yet effective method of retaining rotations that are not too extreme is to solder an extension to the seam on the band and permit this to extend into the body of the retainer. The extension should be placed at an angle counterwise to the direction of the rotation.

#### *Bite Planes*

With the adoption of the newer methods of treatment in which the teeth are tipped distally the use of bite planes to open the bite or to maintain the newly acquired vertical relation is rarely indicated, however, in those cases where collapse seems imminent the addition of a bite plane especially in mixed dentures will often permit the posterior teeth to attain their normal vertical development. Retainers made of acrylic are hard enough to resist the force of occlusion of the anterior teeth and contrary to the experience with vulcanite show little wear even after months of service. In those cases treated before the eruption of the twelve year molars in which it has been necessary to move the six year molars distally the maxillary twelve year molars will often erupt buccal to normal. A simple yet effective method of guiding these teeth to position is to embed a short section of .020 stainless steel wire in the retainer with its free end contoured in such a manner as to engage the buccal surface of the twelve year molars. A very light pressure will in a few days return this tooth to its normal place in the arch.



*Extra Oral Retention*

Where the over-bite is normal Class III malocclusions ordinarily require no mechanical retention, however, in those cases in which the over-bite is shallow it is good practice to insist that the patient use the head cap and chin plate at night and during meals until the operator is certain that the patient is functioning normally during mastication. A good test for this is to give the patient a piece of chewing gum and observe him in action. If he chews with his mandible back in position it is safe to assume that the correction will be permanent.

In the retention of extreme maxillary protractions and double protrusions attempts are now being made to retain these by the use of a heavy labial wire, similar to the old "E" arch, attached to a head cap with the free ends inserted into tubes soldered to the molar bands. This is worn by the patient at night and removed in the morning. So far the use of this method has not been general enough to warrant a report as to its effectiveness.

*Occlusal Grindings*

It is surprising the number of orthodontists who look at their cases only in centric occlusion and seldom observe their patients in lateral excursion, yet the action of the jaws in mastication is largely in a lateral direction. As was shown earlier in this paper a very large percentage of our patients show a lack of harmony in the relative amount of tooth structure present in the two arches. In order to compensate for this, occlusal or spot grinding as it is commonly called should be considered in order to refine our finished result. This is an operation that should be approached with extreme caution and should not be attempted by those who are unfamiliar with this exacting technic. When carefully and correctly done it gives to our cases that finished appearance and refinement in function that is so necessary to a permanently successful result. For a detailed description of the technic of occlusal grinding I refer you to the writings of Dr. David McLean.

## TIME OF RETENTION

To lay down specific rules for the time retainers should be worn is not possible. There are too many variables that enter into the picture—the age of the patient—character and severity of the malocclusion—continuation of habits and other etiologic factors. A rule that was used more or less arbitrarily by the earlier practitioners was to retain the case for a length of time equal to that required for active treatment, but with the introduction of methods of treatment that permitted of more rapid tooth movement this was found to be too short. Except in very young children or in those cases in which only minor tooth adjustments have been indicated it would seem safe to say that the minimum period that retainers should be constantly worn is one year. If plates are used their use should then be gradually eliminated first by leaving them out in the daytime and inserting at night for about six months, then every other night until they can be dispensed with entirely. The upper plate should be discarded some time before the lower as this gives the maxillary teeth a better chance to settle into more intimate contact with those of the mandible. In those cases in which a

cuspid to cuspid retainer has been used in conjunction with a lower plate the fixed retainer can be removed after about six months at which time a new lower plate should be substituted. With our present knowledge of the problems of treatment and retention perhaps we can do no better than follow the advice of Kingsley. "The fruits of a skillful and successful effort at regulating teeth must not be lost by neglecting to retain them in place not only until they have become firm, but until the tendency to return to their former mal-position has been seemingly overcome."

As a result of many sad experiences we are forced to recognize that teeth will continue to move and to settle until they ultimately reach a position where they are in balance with the forces that act upon them.

2300 Durant Avenue