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# Retention in Orthodontics

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**Abstract:** ***Retention is a critical phase in orthodontic treatment, aimed at maintaining corrected tooth positions and preventing relapse. Despite optimal treatment, post-treatment changes are common due to factors like growth, periodontal adaptation, aging, and occlusal forces. Retainers, as passive appliances, help preserve treatment outcomes by stabilizing teeth in their corrected positions. Historical and modern treatment philosophies emphasize the importance of long-term stability alongside aesthetics and function. This review highlights the biological basis of relapse, key contributing factors, and current retention protocols. A thorough understanding of retention is essential for achieving durable and successful orthodontic outcomes***

**Keywords:** orthodontic treatment, retention, orthodontic force, modern orthodontics retainers

## 1. Introduction

Retention is a vital phase of orthodontic treatment aimed at preventing relapse and maintaining the corrected tooth positions. Despite successful correction of malocclusion, teeth often tend to shift back due to biological and mechanical factors, making retention as important as the active treatment phase. Orthodontics has evolved from simply aligning teeth to treating malocclusions comprehensively. Early pioneers like Angle emphasized ideal occlusion without extractions, while modern goals include achieving functional efficiency, aesthetic harmony, structural balance, and long-term stability (Tweed, Jackson's Triad). Retention, as defined by Moyers and Riedel, involves holding teeth in their corrected positions to preserve aesthetic and functional outcomes. Relapse remains a persistent issue influenced by growth, age, third molars, periodontal health, and tooth size. A proper understanding of these factors and effective retention methods is crucial for long-term success.

## 2. History

Retention was largely neglected until the 19th century, despite ancient interest in dental aesthetics. Early references include Galen and Pliny, but relapse concerns emerged with Angell (1860) and Coleman (1865). Brown-Mason (1872), Smith, and Quinbey introduced early retainers.

Angle emphasized stable occlusion and warned against premature appliance removal. Jackson (1904) introduced fiberotomy to control relapse. Case supported overcorrection and fixed retention, while Bonwill and Kingsley highlighted occlusal harmony.

Hawley (1919) introduced the Hawley retainer. Mershon developed the lingual arch. Periodontists like Orban and Reitan linked relapse to periodontal fiber tension, leading to surgical approaches like CSF.

Later, researchers like Schwartz, Reitan, and Muchnic noted post-treatment changes as inevitable. The 1950s–70s saw increased use of reproximation and fiberotomy. Riedel and Kaplan concluded that long-term retention strategies remain essential due to individual variability and growth.

## 3. Basic Theorems of Retention

1) **Teeth Tend to Return to their Original Positions:** Post-treatment relapse is common due to muscle memory, periodontal fibres, and bone structure. Retention is essential to counteract this natural tendency.
2) **Eliminating the Cause Helps Prevent Relapse:** Removing etiologic factors like habits (thumb sucking, tongue thrusting) or addressing underlying skeletal discrepancies can reduce the chance of recurrence. However, many causes remain unknown or unmodifiable, especially hereditary ones.
3) **Overcorrection Improves Long-Term Stability:** Slight overcorrection of malocclusions (e.g., Class II edge-to-edge, overbite) is often practiced, anticipating minor relapse. However, overcorrection must be done judiciously to avoid muscular rebound or postural relapse.
4) **Ideal Occlusion Supports Stability:** Achieving a good static and functional occlusion is important for retention. While it may not prevent all relapse, well-balanced occlusion minimizes occlusal interferences and helps maintain alignment.
5) **Tissues Must Reorganize Post-Treatment:** After tooth movement, bone and periodontal ligaments undergo remodelling. Retainers must be worn during this time to allow stabilization and adaptation of surrounding structures.
6) **Upright Mandibular Incisors Offer Better Stability:** Proper angulation of lower incisors over basal bone, preferably with a slight lingual inclination, enhances post-treatment stability and reduces crowding risk.
7) **Early Treatment is Less Likely to Relapse:** Interventions during active growth phases allow for more stable changes, particularly in skeletal discrepancies. Early treatment can guide proper eruption and minimize later complex movements.
8) **Greater Tooth Movement May Reduce Relapse (with caution):** Extensive movements might result in more stable positions if teeth are moved outside of their original muscular influences. However, this remains debated, and excessive movement could also destabilize the outcome.
9) **Mandibular Arch Form is Difficult to Alter Permanently:** Efforts to widen the mandibular arch, especially intercanine width, often relapse. Maintaining

the natural arch form during treatment ensures more predictable long-term results

**Why is Retention Necessary?**

Orthodontic treatment results are inherently unstable, making retention essential for the following reasons[1]:

1) **Tissue Reorganization**: Gingival and periodontal tissues need time to reorganize after tooth movement.
2) **Instability of Tooth Position**: Teeth may settle in unstable positions, leading to relapse due to soft tissue pressures.
3) **Continued Growth**: Growth-related changes can alter post-treatment outcomes.
4) **Need for Long-Term Support**: In cases of significant tooth movement (e.g., arch expansion), only permanent retention can prevent relapse.

Thus, retention must be maintained until tissues stabilize and growth ceases to ensure lasting results

## 4. Classification of Retention

**1) Minimal/No Retention Needed**

- Corrected crossbites with stable overbite and axial inclinations.
- Class I extraction with high canines and no incisor crowding.
- Mild Class II with stable arches.
- Cases where space was created by molar/bicuspid tipping.

**2) Moderate Retention Needed**

- Class I non-extraction with spacing/protrusion.
- Class I/II extraction cases until muscle balance develops.
- Deep bite corrections (may need bite plane).
- Early corrected rotations (labial bow, splints, or fiberotomy).
- Ectopic/supernumerary eruptions and incisor spacing.
- Class II Div. 2 needing muscle adaptation.

**3) Permanent/Semi-Permanent Retention**

- Arch expansion (esp. mandibular).
- Dual bite corrections (Class II/III).
- Severe spacing, rotations, or malpositions.
- Midline diastema in adults.

**4) Indefinite Retention with Operative Support**

- Tooth-size discrepancies and vertical incisor overlap.
- May involve reproximation or bonding.

**5) Special Appliance Adjustments**

- Due to growth changes or torque/overbite maintenance.

**6) Routine Retention (All Cases)**

- Until third molars are assessed and growth is complete.

**Time for the Initiation of Retention**

As Angle emphasized, once malposed teeth are repositioned, they must be supported until the supporting tissues adapt to their new position. R.G. Alexander (1983) introduced the concept of a "Countdown to Retention," which begins when optimal occlusion is achieved, including centric relation, root parallelism, proper torque, overjet/overbite correction, and Class I relationships.

**Key Criteria Before Initiating Retention:**

1) **Overcorrection of A-P Relationships:** Especially in Class II cases, overcorrect to edge-to-edge and use nighttime elastics for 6–8 weeks.
2) **Correct Anterior Tip & Torque:** Ensure upper and lower anterior teeth have appropriate axial inclinations; adjust torque if lost during treatment (e.g., due to overjet reduction).
3) **Arch Coordination:** Maintain arch width symmetry using coordinated arch wires and cross-elastics as needed.
4) **Posterior Crown Torque:** Ensure correct torque to prevent interferences; pre-adjusted brackets often suffice.
5) **Marginal Ridge & Contact Point Alignment:** Maintain level marginal ridges (<0.5 mm variance) and correct bracket positioning (preferably at crown canter).
6) **Midline Correction:** Use asymmetrical elastics based on the type of discrepancy. Limit use and ensure wires are tied back to prevent distortions.
7) **Occlusal Interdigitation:** Allow teeth to settle post-rectangular wire stage with round wires and vertical elastics before debonding.
8) **Cephalometric Evaluation:** Take progress and final cephalograms to assess incisor position, skeletal correction, and occlusal plane changes.
9) **Root Parallelism:** Confirm with a panoramic x-ray before debonding. Correct severe deviations via bracket repositioning or wire bends.
10) **Space Closure:** Use passive tiebacks to prevent reopening, especially in extraction cases.
11) **Facial Aesthetics:** Continuously assess profile and facial symmetry through clinical observation and cephalometric analysis.
12) **TMJ Function:** Document pre-treatment status, monitor during treatment, and manage dysfunctions with splints or modified mechanics.
13) **Functional Movements:** Ensure proper anterior guidance in protrusion and canine rise in lateral excursions. Band second molars if necessary.
14) **Habit Elimination:** Confirm correction of habits like tongue thrust before debonding.
15) **Rotations and Overcorrection:** Address residual rotations with wedges or lingual elastics and overcorrect slightly to prevent relapse.
16) **Occlusal Plane Levelling:** Aim for a flat occlusal plane; avoid leaving curve of Spee, especially in deep bite cases, to ensure occlusal stability.

**Proper Occlusion and Stability**

Kingsley emphasized that occlusion is the most critical factor for retention and post-treatment stability.

**Andrews' Six Keys to Normal Occlusion (1972):**

**1) Molar Relationship**

- Ideal cusp interdigitation between upper and lower molars ensures functional occlusion.

**2) Crown Angulation (Tip)**

- Refers to the mesiodistal angulation of the crown.
- Gingival portion should be distal to the incisal edge.

**3) Crown Inclination (Torque)**
- Labiolingual or buccolingual inclination of the crown.
- Maxillary incisors: gingival crown portions are lingual; posterior
- crowns inclined buccally or lingually as needed.

**4) Absence of Rotations**
- Prevents space discrepancies; rotated molars disrupt occlusion.

**5) Tight Contacts**
- No spacing between adjacent teeth; crucial for stability unless true tooth-size discrepancy exists.

**6) Occlusal Plane**
- Should be flat to mildly curved (Curve of Spee); flat planes favor better intercuspation and stability.

**Growth Patterns and Stability**
- **"Good growth pattern"**: Horizontal facial growth → better stability and retention.
- **"Poor growth pattern"**: Vertical growth tendencies → higher risk of relapse.
- The classification of growth patterns reflects clinical experience rather than strict scientific evidence.

## 5. Problems of Retention

**1) Biological Factors:**
- **Transseptal fibres** resist tooth movement and cause relapse, especially after space closure.
- These fibres cannot easily remodel and tend to return teeth to their original positions.
- Historical views (Oppenheim, Walkoff, Thompson) confirm their role in relapse.

**2) Mechanical Factors:**
- Ideal occlusion is hard to achieve in **extraction cases** due to torque limitations.
- **Arch expansion** and non-physiological retention can damage tissues.
- **Diphasic treatment** (early skeletal + later dental phase) helps improve long-term outcomes

**Definition**
Retainers are passive orthodontic appliances used post-treatment to maintain tooth positions and allow periodontal stabilization.

**Ideal Requirements (Graber):**
- Prevents relapse.
- Allows functional adaptation.
- Hygienic and easy to clean.
- Aesthetic and durable.

**Classification**
- Removable Retainers
- Fixed Retainers
- Active Retainers

**I. Removable Retainers**
Used for maintaining intra-arch stability. Common types:

**1) Hawley Retainer**
a) **Design**: Labial bow, molar clasps, palatal acrylic.
b) **Uses**: General retention, post-extraction space maintenance.
c) **Drawbacks**: Bulky, affects speech/taste, allergy risk.
d) **Modifications**:
- **Ali Bahreman Loops**: Prevent canine rotation.
- **Jerrold Design**: All-wire, no acrylic palate.

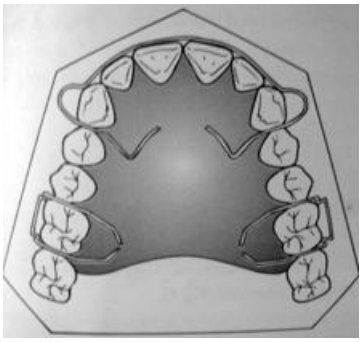

**Figure 1:** Standard design of Hawley's retainer

**2) Wraparound Retainer**
a) **Design**: Wire wraps labial/lingual surfaces.
b) **Uses**: Full arch retention, splinting in perio cases.
c) **Advantages**: Aesthetic avoids occlusal interference.
d) **Limitations**: Less overbite control, potential distortion.

**3) Fitted Labial Bow**
a) **Design**: Closely adapted wire with U-loops.
b) **Use**: Passive retention only.
c) **Limitation**: No active movement.

**Figure 2:** Begg wrap-around retainer

**4) High Labial Retainer**
a) **Design**: High labial wire + springs on thin acrylic.
b) **Uses**: Retention + minor tooth movement.
c) **Advantages**: Precise control, easy adjustment, aids finishing.

**5) Removable Cuspid-to-Cuspid Retainer**

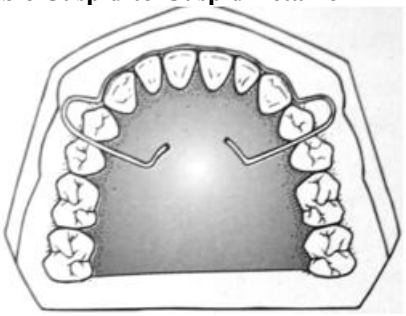

**Figure 3:** Fitted labial bow

Developed by Shilliday to combine the benefits of Hawley and fixed lingual retainers. It uses 0.025" wires between cuspids and laterals with labial and lingual acrylic coverage. Quick to fabricate, suitable for controlling anterior rotations. Avoids issues with mandibular tori and is aesthetically acceptable.

**Figure 4:** High labial retainer

**6) Removable 6-6 Metal Retainer**

Developed by Hoffman, this retainer uses a 0.045" stainless steel lingual arch with Adams clasps. Offers robust retention, avoids acrylic issues, and allows attachments for minor tooth movement or expansion.

**7) Non-Acrylic Removable Retainer**

Constructed of 0.9mm wire with Adams and ¾ clasps, designed to prevent inflammation associated with acrylic in sensitive patients. Leaves the palate uncovered, improving comfort.

**8) Continuous Clear Retainer**

A wire-acrylic retainer with circumferential retention and no occlusal interference. Provides high accuracy and allows vertical settling. Cold-cure acrylic is used, with labial wires for esthetics and control.

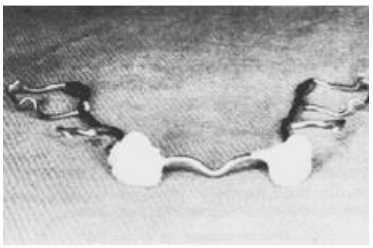

**Figure 7:** Non-acrylic removable retainer.

**9) Retainer Splint**

A night-worn, acrylic-and-wire appliance replacing fixed lingual retainers. Retains lower anteriors, may include buccal segments for expansion or space maintenance. Durable, easy to fabricate, and adjustable.

**Figure 8:** Continuous Clear Retainer

**10) Removable Plastic Herbst (RPH) Retainer**

A dual-arch retainer with upper/lower splints connected by a telescoping Herbst mechanism. Prevents Class II relapse. Also useful as a finisher, retreatment device, post-surgical retainer, sleep apnea aid, and TMJ splint.

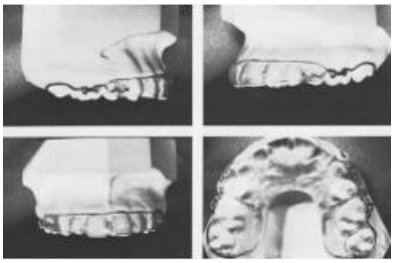

**Figure 9:** Retainer splints showing the use of an upper splint to maintain space for small, malformed lateral incisors

**11) Essix Retainer**

Thin, thermoplastic full-arch retainer offering esthetic, durable, and hygienic retention. Delegates responsibility to the patient. Can be worn full-time initially, then nightly. Versatile in correcting minor movements, serving as a temporary prosthesis, night guard, or bite plane

## 6. Conclusion

Preventing post-treatment changes in orthodontics remains challenging and requires patient cooperation. Fixed retainers need regular monitoring to avoid failure and hygiene issues, while removable retainers demand consistent wear and maintenance. Long-term retention is essential, as relapse is unpredictable without it. Thus, retention should be emphasized as much as active treatment from the outset.

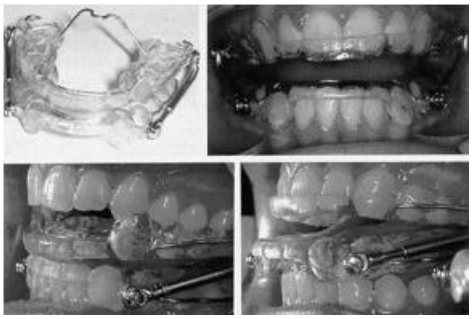

**Figure 10:** Removable Plastic Herbst retainer, with upper and lower occlusal splints connected by the Herbst mechanism

**Figure 11:** Patient before and after the placement of Essix retainers

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