

Is Retention In Orthodontic Treatment Effective??

Community Dentistry 300Y

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Abstract:

The purpose of this review of the literature was to determine the effectiveness of retention in orthodontic treatment. Specifically, types of retainers and factors for relapse were explored. The studies examined were based on retention following orthodontic treatment (i.e. retainers). Evidence was gathered from a number of different sources, including four database websites: PubMed, American Dental Association (ADA), Canadian Dental Association (CDA), and the International Dental Database; an orthodontic textbook; and personal correspondence with qualified orthodontists. After analyzing all potentially relevant articles, 8 journal articles were considered as applicable to the topic. They were critically analyzed with the use of either an 'efficacy' checklist or a 'causation' checklist, depending on the study. The views expressed by the experts and the information from the textbook helped to augment and confirm the information in the articles. The highest score awarded to any article was a 7 when using the causation checklist and a 14 when examining efficacy. Conflicting results were found with nearly all of the studies, with many presenting with multiple weaknesses in their study designs. The lack of randomized control trials made evaluating the studies for concrete conclusions very difficult. In addition, small sample sizes may also have affected the results. The consistent conclusion appeared to be that there is, in fact, no perfect way to ensure retention following orthodontic treatment.

**Introduction:
Background and Purpose**

Retention is defined as the phase of orthodontic treatment that attempts to keep teeth in their corrected position following orthodontic braces, and is thus a very integral part of the treatment (Littlewood, 2004). Without a means of retention, orthodontic treatment results are potentially unstable and may revert back to their pre-treated form due to three major reasons: (1) the gingival and periodontal tissues affected by orthodontic tooth movement require time for reorganization after the appliances are removed; (2) soft tissue pressures surrounding oral cavity exert pressures tending toward relapse; and (3) changes produced by growth may alter the therapeutic alignment of teeth (Proffit, 2005). Relapse occurs when these forces unfavorably move the teeth from their corrected positions. To minimize this relapse tendency almost every patient who has orthodontic treatment will require some type of retention (Littlewood, 2004).

Retention can be achieved by placing appliances known as retainers. There are different types of retainers, broadly divided into either removable or fixed (Proffit, 2005). The type of retainer used and the duration of retention is highly variable from one patient to another, mostly depending on the orthodontist's selection (Melrose, 1998; Destang & Kerr, 2003; Kellerstein, 2006). However, it is an accepted theory that the time of retention must be at least the amount of time necessary for the periodontal fibers around the teeth to reorganize into their new positions (Destang & Kerr, 2003). Unfortunately, even in patients who wear retainers for at least a year, the long term post-retention stability has still shown to be poor, indicating relapse in approximately half of the cases (Little, 1990).

Recognizing the vast parameters of retention, this report attempts to explore the different types of retainers available to maintain tooth position, as well as identify the factors associated with relapse.

Target Population:

The problem outlined in this report is based on the need for orthodontists to develop strategies to help maintain retention following orthodontic treatment. Patients, individuals financing the orthodontic treatment at hand (in many cases parents/guardians), and orthodontists themselves want to know that the post-treatment occlusion is going to be maintained, or at least one that is deemed acceptable by all those involved.

The Problem of Retention:

With the cost of orthodontic treatment, both financially and physically, it is important for orthodontists to take into account all parameters for relapse. However, no single method of retention has yet been accepted that produces *ideal* results (Russell, 2004). Despite the number of individuals in demand of, and receiving orthodontic care, the problem of retention and relapse still remains. In an effort to provide evidence concerning the effectiveness of retention in orthodontic treatment we attempted to address the following questions: What are the relative successes of current types of retainers? What factors most influence the risk of relapse? How does an orthodontist determine which method of retention to give a patient?

Structure of this Report:

The evidence on the topic of the effectiveness of retention following orthodontic treatment will be discussed in this report. The following areas will be examined, as per the design utilized by Leake et al. (1996):

1. Search strategy
2. Inclusion Criteria
3. Summary of evidence
4. Comparison of outcomes from different studies

5. Evidence-based recommendations
6. Future research

Evidence for the Effectiveness of Orthodontic Retention Following Treatment:

A.) Search Strategy:

Three search strategies were applied to help locate potentially relevant articles. Internet based research was conducted through four different websites: PubMed, American Dental Association (ADA), Canadian Dental Association (CDA), and the International Dental Database. Each website was exhaustively searched by title using various search terms, such as types of orthodontic retainers, orthodontic retainers and relapse, orthodontic retention and effectiveness, lingual retainer's effectiveness, and orthodontic retention following treatment, etc. (See Appendix: Table 1 for a complete list of keywords). With PubMed, all of the search terms were combined and resulted in a total yield of 506 potentially relevant articles (See Table 1-1). Eliminating irrelevant titles first narrowed down the results and left 42 potential articles. Out of these 42 articles, there were 15 duplications; the remaining 27 articles were then cut down to 14 articles following the stages of elimination by abstract, full article review and the requirements of the inclusion/exclusion criteria. Keywords such as orthodontic retention, orthodontic retainers, and orthodontic relapse were used to locate relevant articles on the CDA and ADA websites; unfortunately no relevant articles were found (please refer to Table 1-2). However, by using the same key words, one additional article was located through the International Dental Database (See Table 1-2).

Secondly, manual research of the textbook Contemporary Orthodontics, by Proffit (2005) was reviewed for additional relevant material. This process did not yield any articles.

Lastly, several experts were asked to help us identify factors regarding the types of retainers to be used, the minimum retention time for different retainers, the factors that define the effectiveness of orthodontic retention, as well as any publications that may aid in answering the questions. The specific questions asked of the experts were as follows:

1. How do you choose what types of retainers you give to a patient?
2. How long do you recommend the retainers be worn for?
3. What factors determine whether retention will be adequate? How do you counteract these factors to enforce retention?

This process yielded one potential article, but was later eliminated as irrelevant.

By utilizing the above three search strategies, a total yield of 15 articles were identified to be relevant to our topic, with 8 being used in the final report.

B.) Inclusion and Exclusion Criteria

During the process of elimination, each article had to fulfill the predetermined inclusion and exclusion criteria in order to be considered for use in answering the problem. The title of the article had to be relevant to our question. For the abstract phase, the publication had to be in English, treat only human subjects, be a primary article, and be accessible via the University of Toronto database in order for it to be printed online or copied from a reserved journal in the campus library. The full article was then reviewed to ensure its applicability to our topic as well as its strength of research design and findings. Finally, two independent individuals of the team were asked to critically score the remaining articles by using the appropriate checklist (see Critical Appraisal Criteria below). Disagreements were resolved by consulting other group members in the team, using the same criteria. Although these inclusion criteria may appear to be somewhat broad, it should be noted that more specific criteria was especially difficult to

establish due to the nature of our subject and the studies available for review. Our question itself was complex and multi-dimensional, and the existing literature was poor in terms of critically examining the topic at hand due to the lack of randomized control trials. Therefore any further exclusion criteria would have left us with insufficient papers for a thorough and proper analysis.

C.) Critical Appraisal Criteria:

The validity and quality of each article was carefully scored according to an appropriate checklist. Two different checklists were utilized. The first was used to assess evidence of efficacy of therapy or prevention that was customized to apply to 9 corresponding articles. Here, total check-off scores (with 100% correspondence) were set to be 15, 16, and 17 depending on the individual article at hand. A common cut-off value with a minimum of 12 had to be met in order to be included in the selection process, this means there must be a minimum of 70% (12/17) correspondence (refer to the evidence table in Appendix 2). Four articles remained after the evaluation. The second checklist was used to assess causation and was applied to the 6 remaining articles that had not yet been scored. A total score of 9 with a minimum score of 7 was set to be the cut-off. This process yielded 4 additional articles. Therefore, out of the 15 potentially relevant articles, 8 articles were identified to be relevant to our topic and are highlighted within the evidence table (see Appendix 2).

Summary of the Evidence

First we must make note of the fact that when exploring the literature for studies investigating whether or not retention in orthodontics is effective, it was immediately apparent that no studies existed employing the design of a randomized controlled trial. While this type of study design would offer the most convincing evidence, it was likely not made use of because of ethical considerations; simply no study wanted to assign subjects to a true control group which

would not receive any means of retention, knowing that the likely outcome would be a negative one, namely relapse.

A.) Prevalence/Incidence

The rates of those in demand of and those receiving orthodontic treatment helps us to see why effective orthodontic retention is such an important issue.

Only two studies were found reporting rates discovered in Canada. The more recent study was undergone in Manitoba, and investigated the orthodontic treatment needs of a group of 6 and 9-year-old children, finding that 28% of this population would face orthodontic problems in the future. It also reported that no statistically significant differences existed between age or gender groups (Karaiskos, 2005). A somewhat older study done in Quebec looked at the occurrence of malocclusions and orthodontic treatment needs in 13 and 14-year-old children, finding that 32% were in Angle's class II; 18% had an overjet of at least 5 mm; and 50% had at least one tooth in an improper position (Payette, 1989).

The remainder of the studies reported rates found in the United States of America. In Cleveland, a survey of 2,808 tenth grade students enrolled in either public or private high schools reported the rate of orthodontic utilization to be 37% (Nelson, 2004). A study in North Carolina found that 57% to 59% of the population belonging to each racial/ethnic group had some degree of need for orthodontic treatment, and more than 30% of white youths, 11% of Mexican-American youths, and 8% of black youths identified having received treatment (Profitt, 1998). The need for orthodontic intervention was examined in 3639 third and fourth grade children in Florida (n = 3696). It was found that 41.8% of girls and 44.2% of boys required treatment (Wheeler, 1994).

As it can be seen, orthodontic treatment is of great value to a large percentage of the population as it not only restores function to those with malocclusions but can also improve one's appearance in the highly esthetic world we live in today.

B.) Types of Orthodontic Retainers

After an unsuccessful attempt in finding randomized controlled trials offering true control groups, we decided to search the available literature for other types of studies which might have offered us some insight into determining whether or not retention in orthodontics is effective. We came across a number of studies that examined different means of retention, reporting either their effectiveness alone or in comparison to another means of retention.

Fixed Retainers

Segner et al (2000) performed a retrospective study which assessed the reliability of bonded retainers. Among his results, he reports that these retainers were not responsible for causing caries, and that the majority of retainer breakages or losses occurred in the first 3 to 6 months. More importantly he concluded that bonded retainers were highly competent and dependable in maintaining tooth alignment. While this study did have the largest sample size of those included in this paper, thereby contributing to its fair level of evidence, the lack of a control group prevents true and significant findings that retention was due to the bonded retainers preventing tooth movement and not simply to the absence of attempted movement by the teeth themselves.

Fixed versus Removable Retainers

Artun et al (1997) carried out a study comparing 4 types of retainers. Subjects were divided into 4 groups, 3 groups receiving each a different version of bonded retainer while the 4th group received a removable retainer and served as the control group. His paper reported that the

4 types of retainers were equally capable of maintaining incisor positioning. This study is considered to be a randomized-controlled trial, and with such a strong design it has the highest level of evidence. However there is at the same time the lack of a *true* control group that would have ideally received no means of retention at all.

Lang et al (2002) also performed a study looking for associations between fixed or removable retainers and relapse. This retrospective study with a fair level of evidence found firstly that was some degree of relapse existed even with long-term retention in both arches, however the amount of movement was less pronounced if the retainers were still in use. It was reported that removable retainers were more successful in preventing arch-width collapse since bonded retainers do not extend to the posterior teeth.

Fixed versus Fixed

Stormann and Ehmer (2002) compared tooth position after use of 2 different sized wires of fixed canine-to-canine retainers (bonded to each tooth), and 1 canine-and-canine retainer (bonded only to two teeth). Their randomized prospective study also provided a fair level of evidence in finding that canine-and-canine retainers were less successful than canine-to-canine retainers, and that thicker wires were less successful than thinner wires in preventing relapse

Circumferential Supracrestal Fiberotomy

Edwards (1988) investigated a less prescribed means of retention which involves a surgical process where a blade is inserted into the gingival sulcus severing the epithelial attachment surrounding the teeth as well as the transeptal fibers. The study divided subjects into 2 groups, prescribing the CSF procedure and a removable nightly retainer to the first group, and only a removable retainer to the second group to serve as a control. Although the randomization process was done inappropriately (alternating assignments of subjects to the 2 groups) thereby

granting the study only a fair level of evidence, the study reports that the CSF procedure was more efficient than a removable retainer alone especially in preventing purely rotational relapse. In addition, similar to most studies on the matter, some degree of relapse was noted in all cases even where a means of retention was utilized.

C.) Factors Associated With Relapse

After researching the above articles, it was more than obvious when examining the effectiveness of orthodontic retention that an important consideration is possible factors which may increase the risk of relapse and therefore be confounding factors when comparing the various methods of retention. In discovering this, we deemed it necessary that we at least touch on this topic as it is relevant to our question.

Destang and Kerr (2003) performed a short-term prospective study investigating the effect of retention time on relapse. This randomized study offered a fair level of evidence suggesting that a shorter duration of retention was associated with a greater degree of relapse. What was especially likeable about this study was that it was the only of its kind which presented a biological plausibility for relapse, being it that the periodontal ligament requires a specific amount of time to reorganize its fibers into the newly aligned position.

Ormiston et al (2005) conducted a retrospective controlled study where subjects were organized into a “stable” or “unstable” group determined by the degree of relapse they experienced and looked for common factors among the groups. This study also presented a fair level of evidence suggesting that pre-treatment arch length, pre-treatment peer assessment rating (PAR) score, molar classification, and gender were all clinically significant factors in predicting relapse. On the other hand the study found that age at start of treatment, length of treatment,

retention time, post-retention time, extraction, and type of retainers are not significant in predicting relapse.

Little (1990) performed a study with a very large number of subjects. His findings provide a fair level of evidence that only extraction and arch enlargement during the orthodontic treatment phase were associated with relapse; while length of retention, age of start of treatment, Angle classification, gender, and cephalometric radiographs prior to and following treatment did not seem to be useful predictors.

D.) Expert Opinion

According to interviews with orthodontists, retention needs are divided into three categories. Limited retention is needed for crossbites and serial extraction cases. Class 1 non-extraction cases, Class 1 or 2 extraction cases, corrected deep overbites, rotated teeth, and Class 2 division 2 malocclusions required moderate retention. Permanent or semi-permanent retention is imperative for expansion cases, spacing cases, severe rotation, correction of midline diastema (Rosenberg, 2006). It is highly recommended that a retainer be worn for at least 6-12 months full-time for upper removable retainers and every night for an additional year and occasionally after that. When using bonded retainer, the general rule is that the retainer be worn for at least the length of the treatment time. For example, if braces were worn for 2 years, then the bonded retainer must be worn for at least 2 years post-treatment. It is not unusual for bonded to retainers to be worn for 5-10 years, or longer (Posluns, 2006). The choice of the retainer is individualized. There are a number of factors that can be considered prior to retainer selection, including:

- Severity of malocclusion
- Degree of tooth rotation
- Quality of Finish

- Growth remaining
- Dental IQ and Oral Hygiene
- Missing Teeth

Finally, expert opinions state that there are many factors that may affect the potential for relapse. Most importantly are: latent growth, degree of dental compensation, a stable balanced oral environment, patient compliance, cessation of habits, and the health of teeth (Posluns, 2006). In order to have any chance for retention, patient compliance is imperative (Kellerstein, 2006; Posluns, 2006).

In compiling the findings from the above studies and experts it can be seen that there is a contradiction in the results; what some studies found to be significant factors in predicting relapse, other studies found to be unreliable. Since every study reviewed was only able to offer a fair level of evidence, all that can truly be concluded is that the risk of relapse simply cannot be predicted.

Summary of Findings and Recommendations:

1. A large percentage of the population will require a means of retention after undergoing orthodontic treatment, and therefore it is important to determine the most effective means of preventing relapse (Blake & Garvey, 1998).
2. Some degree of relapse is always found, even in cases where long-term methods of retention are in place.
3. Removable retainers may be more successful in preventing arch-width collapse and therefore should be considered when planning retention for patients who have undergone orthodontic arch expansion (Lang, 2002).

4. Fixed retainers bonded to all teeth in the segment are likely more successful than those bonded only to the outermost teeth in the segment and therefore should be the technique of choice (Stormann & Ehmer, 2002).
5. CSF may be considered when planning retention for patients who had severe rotational malpositioning prior to orthodontic treatment (Edwards, 1998; Taner, 2000).
6. The risk of relapse cannot be predicted! While various factors are thought to have some association with teeth reverting back to non-ideal positioning, the risk of relapse is simply an individualized problem.

Conclusions:

These research findings and expert opinions show that orthodontic retainers are, to a certain extent, effective in preventing relapse. However, no study was able to determine a single and most successful method of retention, nor was there an explanation on how to ideally prevent the problem of relapse following orthodontic treatment. Finding a “perfect retainer” for patients is difficult because orthodontic retention is an individualized problem. In many cases, teeth will revert back to imperfect positioning regardless of the type of retainer used, as even permanent retainers cannot ensure tooth placement (Lang et al., 2002). Relapse is a complex phenomenon that involves numerous factors. Furthermore, teeth themselves have a natural tendency to go back to their pre-treatment positions. Our suggestion, which is in accordance with many of the articles reviewed on this topic, is that the best way to minimize relapse is to use as many different retainer types as possible. For example, Kellerstein (2006) has recommended the use of fixed lingual canine-to-canine retainers in addition to removable retainers.

Future Considerations:

Additional literature searches should take into account the duration of treatment, to determine whether it has an effect on retention following orthodontic treatment. Surveying a larger number of qualified orthodontists would be beneficial, as it would potentially show a preference for certain retainers. A large number of specialists could be contacted through email, letters, phone calls, and personal interviews.

The use of randomized control trials are imperative to help solve the problem of retention following orthodontic treatment. In order to obtain strong evidence for the effectiveness of retainers, it is necessary to randomly assign patients to a retainer versus no retainer group. However, conducting this kind of study is unlikely due to ethical and financial constraints. Problems include the high probability of relapse and the cost of re-treatment following relapse for subjects without retainers. It is more likely that randomized controlled research could be used in the comparison of different types of fixed and removable retainers for different lengths of time. Researchers also need to examine other factors such as the durability of the materials used and the type of bonding material used to attach the lingual bar more in-depth (Butler & Dowling, 2005; Stormann & Ehmer, 2002). In addition, future research needs to employ larger sample sizes and longer follow-up times in order to attain stronger evidence.

Appendix 1: Internet-Based Research: Yield of Potentially Relevant Articles Through Systematic Elimination.

Table 1-1: PubMed

Search term	Yield	Yield by title	Yield by abstract	Yield by full article
Types of orthodontic retainers	15	4	2	0
Orthodontic retainers and relapse	89	12	4	1
Orthodontics and retention effectiveness	14	1	0	0
Lingual retainer's effectiveness	89	2	0	0
Orthodontics retention following treatment	89	4	4	4
Effectiveness of orthodontic retention following treatment	4	2	0	0
Effectiveness of retention following orthodontic treatment	13	1	0	0
Factors for stability following orthodontic treatment	16	1	0	0
Types of orthodontic retainers	11	2	2	2
Retention following orthodontic treatment	10	2	1	1
Non-retainer following orthodontic treatment	0		0	0
Effectiveness of orthodontic retention	14	1	0	0
Factors in planning orthodontic retention	24	1	0	0
Little rim	46	2	1	1
Orthodontic retention types	56	4	4	4
Orthodontic retainer types	16	4	1	1
Total	506	42	19	14

Table 1-2: ADA, CDA, and Dental Database

Website	Search terms	Yield	Yield by title	Yield by abstract	Yield by full article
CDA	Ortho retention	340	0	0	0
	Ortho retainer	248			
	Ortho relapse	250			
ADA	Ortho retention	3	0	0	0
	Ortho retainer	2			
	Ortho relapse	33			
Dental Database	Ortho retention	885	5	2	1
	Ortho retainer	680	1	0	0
	Ortho relapse	679	1	1	0
	Hawley retainer	49	2	1	0

Appendix 2: Evidence Tables of Included Studies

<i>Study</i>	<i>Population</i>	<i>Intervention/Tx</i>	<i>Control</i>	<i>Outcome</i>	<i>Critical Appraisal Comments</i>	<i>Conclusion, Strength of Evidence, Classification</i>
Segner and Heinrici, 2000	Subjects: 549 Age: two thirds of the population were adult and the average age was 23.3 Sex: both M & F Location: Hamburg, Germany	-549 patients with retainers were analyzed with regard to wearing time, extension of the retainer, mean time between failures, operator, and age of patient.	NONE	-None of retainers investigated responsible for inducing new caries -no obvious relapse in terms of new irregularities as long as retainer intact in the mouth. -Majority of breakages/losses occur during the first 3-6 months. -bonded retainers represent a highly efficient and reliable retention appliance suited to long term use	<u>Strengths</u> -large sample size -divided subjects into groups according to retainer type allowing for controlled analysis <u>Weaknesses</u> -no control -different operators -most of subjects were adults... may not be representative of average ortho practices	Checklist Score (efficacy): 12 /16 CTFPHE Level of evidence: B (fair) Grades: II-2 (retrospective)
Artun et al, 1997	Subjects: 49 Age: adolescents and adults Sex: both ?M ?F Location: ?(Europe)	1.thick plain wire bonded only to canines (n=11) 2.thick spiral wire bonded only to canines (n=13) 3.thin flexible spiral wire bonded to each tooth (n=11)	removable retainer (n=14) (not a true control)	-4 types equally efficient in maintaining incisor alignment -bonded canine-to-canine retainers effectively maintain incisor alignment -occasional relapse in retainers bonded to canines only	<u>Strengths:</u> -RCT -No withdrawals -Subjects classified by age, gender, and gingival condition before randomization (control for confounding factors of relapse) <u>Weaknesses:</u> -Not a true control -Small sample size	Checklist Score (efficacy): 13/15 CTFPHE: Level of Evidence: A (good) Grade: I (RCT)
Lang et al, 2002	Subjects: 132 Sex: 78M, 54F	-analyzed extent of post-therapeutic changes and	NONE	-factors assoc w/ predicting stability were: • pretreatment	<u>Strengths:</u> -Large sample size -Same operator	Checklist Score (causation): 7/9

	Age: <9->18 Location: ? one privately practicing orthodontist	possible correlations w/ <ul style="list-style-type: none"> retention time retainer type gender angle classif tx-induced changes initiation, type, duration of therapy extraction of PM's 		arch length <ul style="list-style-type: none"> pretreatment PAR score molar classificat'n Sex -factors found not to be significant: <ul style="list-style-type: none"> Age at start of tx Tx time Retention time Postretention time Extractions Type of retainer 	<u>Weaknesses:</u> - Investigated too many other factors with relapse, not giving full attention to retainer type - No control for confounding relapse factors	CTFPHE: Level of Evidence: B (fair) Grade: II-2 (retrospective)
Study	Population	Intervention/Tx	Control	Outcome	Critical Appraisal Comments	Conclusion, Strength of Evidence, Classification
Stormann and Ehmer, 2002	Subjects: 103 Age: 13-17 No periodontal problems Previously treated with removable and fixed appliances	-0.0195" canine-to-canine retainer (bonded to 6 teeth) -0.025 canine-to-canine reatiner -Canine-and-canine retainer	NONE	-Irregularity index used -0.0215 had highest detachment rate, while canine-to-canine retainer had lowest. -No relapse with 0.0195, 20% with 0.0215, and 80% with canine-and-canine(only significant result) - Increased oral hygiene problems for all	<u>Strengths:</u> -Randomized, prospective -Gender distribution equal -Appropriate ages of subjects -Fabrication and insertion of wires under complete control <u>Weaknesses:</u> -Randomization not controlled -No control for confounding relapse factors	Checklist (efficacy): 14/16 CTFPHE: Level of Evidence: B (fair) Grade: II-1 (randomized)
Edwards, 1988	Subjects: 320 Age: 10.9-14.1 Sex: 190F, 130M Location: North Carolina,	CSF with removable retainer (at night only)	No CSF and removable retainer (at night only?)	-difference between mean relapse in CSF and control cases highly significant -CSF appears to be most effective in alleviating	<u>Strengths</u> -study carried out for long period of time -large sample size <u>Weaknesses:</u> -poor	Checklist Score (efficacy): 12/17 CTFPHE: Level of Evidence: B (fair)

	USA			relapse during 1st 4-6y after ortho tx	randomization (alternate tx and control) -withdrawals not reported (and no treating of analysis)	Grade: II-1 (Prospective, Randomized)
Destang and Kerr, 2003	Subjects: 38 Class I or II malocclusion Age: 11 - 19 Sex: both ?M ?F Location: Scotland	1 year Hawley, n=18 (6 mos full time, 6 mos night only)	- 6 mos Hawley, n= 20 (3 months full time, and 3 months night only)	-Longer use of retainer is better. -Less relapse with the 1 year group -Periodontal ligament takes at least 6 months to reorganize after orthodontic tx.	<u>Strengths:</u> -appropriate age group -only study found suggesting biological plausibility for relapse and the need for retention <u>Weaknesses:</u> -small sample size -post-treatment follow up short (3 mos) -only done on maxilla -no control for confounding variables	Checklist Score (causation): 7/9 CTFPHE: Level of Evidence: B (fair) Grade: II-2 (cohort)
Study	Population	Intervention/Tx	Control	Outcome	Critical Appraisal Comments	Conclusion, Strength of Evidence, Classification
Ormiston et al, 2005	Subjects: 86 Sex: 30M, 56F Age: Location: Washington, USA	-“Stable” group n=45	“unstable” group N=41 (2 groups compared to identify factors assoc w/ stability)	-factors assoc w/ predicting stability were: • pretreatment arch length • pretreatment PAR score • molar classificat’n • Sex -factors found not to be significant:	<u>Strengths:</u> -appropriate age group -only study found suggesting biological plausibility for relapse and the need for retention <u>Weaknesses:</u>	Checklist Score (causation): 7/9 CTFPHE: Level of Evidence: B (fair) Grade: II-2 (retrospective, case-control)

				<ul style="list-style-type: none"> • Age at start of tx • Tx time • Retention time • Postretention time • Extractions • Type of retainer 	-small sample size -post-treatment follow up short (3 mos) -only done on maxilla -no control for confounding variables	
Little, 1990	Subjects: 600 Age: early and late adults Sex: both ?M ?F Location: Washington, USA	-treated premolar extraction cases -treated non – extraction cases with generalizes spacing - cases treated by arch enlargement strategy	-untreated normal occlusion cases	-crowding after retention is variable and unpredictable <i>-length of retention, age of start of treatment, Angle classification, gender, dental cast, cephalometric variables</i> not useful predictors <i>-PM extraction and Arch enlargement</i> associated with relapse; require permanent retention. <i>- Generalized spacing</i> most ideal long-term result	<u>Strengths:</u> - Longitudinal study over 30 years -Large sample size -Control group used <u>Weaknesses:</u> - Not ideal control group - Only mandibular arch considered	Checklist Score (causation): 7/9 CTFPHE: Level of Evidence: B (fair) Grade: II-2 (cohort)

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