Moestopo International Review on Societies, Humanities, and Sciences (MIRSHuS)
Vol. 5, No. 2 (2025) pp. 278-293
ISSN: 2775-9601

CAUSES OF ORTHODONTIC TREATMENT RELAPSE

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ARTICLE INFO
Article History:
received: 16/12/2024
revised: 12/09/2025
accepted: 04/10/2025

Keywords:
Rosella; *Hibiscus sabdariffa* L; Effectiveness; Antibacterial; Bacteria

DOI:
10.32509/mirshus.v5i2.106

ABSTRACT
Orthodontic treatment is one type of treatment performed in the field of dentistry aimed at regulating the arrangement of the teeth. Relapse is the movement of teeth back to their original position after orthodontic treatment. Relapse in orthodontic treatment is a complex problem with many factors potentially affecting the treatment outcome. The detailed causes of relapse are not yet known, but there are several factors that can affect the periodontal ligament, alveolar bone, facial structure growth, soft tissue pressure and interdigitates. In addition to previously mentioned factors, tongue thrust, mouth breathing, nail biting, and bad lip habits could lead to relapse of orthodontics treatment. However, relapse can be prevented by good retention of the teeth to stabilize the correction. **Objective**: To explain the causes of relapse in orthodontic treatment. **Methods**: Databases, such as PubMed and Google Scholar, were used as primary source of information. Included literatures were ranged from 2012 to 2024, written in English or Bahasa, and has publicly available full article version. **Results**: A total of 22 references were found and relevant to the topic of causes of relapse in orthodontic treatment. **Conclusion**: In conclusion, relapse of orthodontic treatment was caused by various factors including periodontal ligament, alveolar bone, facial structure growth, soft tissue pressure and interdigitation. In addition, tongue thrust, mouth breathing, nail biting and lip habits were also considered as compounding factors of orthodontic treatment relapse.

INTRODUCTION

Orthodontic relapse is defined as the tendency of teeth to return to their pre-treatment positions or to undergo undesired movements following the completion of orthodontic therapy. Relapse is a multifactorial phenomenon; there is no single causative factor, but rather an interaction among several components, including periodontal structures, soft tissues, growth, occlusion, treatment techniques, retention methods, and patient compliance. These factors are critical in designing an effective retention protocol and minimizing the likelihood of relapse. From a biological perspective, the periodontal tissues play a fundamental role in maintaining post-treatment stability. The elastic periodontal fibers have a natural tendency to pull the teeth back toward their

original positions if the remodeling process of the supporting tissues has not been fully completed. Poor periodontal conditions can further compromise stability; therefore, the regeneration and health of periodontal tissues should be optimized prior to initiating the retention phase (Chacón-Moreno et al., 2022) . Additionally, soft tissue influences, such as the forces exerted by the lips, cheeks, and tongue, can induce undesirable tooth movement after active treatment. This is consistent with the findings of Lyros et al. (2023), who explained that muscular imbalance can apply continuous pressure on the dentition, resulting in positional changes even in patients who comply with retainer use. Furthermore, adverse oral habits such as tongue thrusting and excessive lip pressure have been reported as major contributing factors to anterior tooth relapse. Physiological changes associated with aging, such as the natural forward migration of mandibular anterior teeth, may also contribute to relapse despite proper retainer use (I. Lyros et al., 2023).

Technical factors during orthodontic treatment—such as overexpansion of the dental arch, excessive incisal inclination, or improper torque control—can likewise compromise post-treatment stability (Inchingolo et al., 2023). In cases involving orthognathic surgery or significant facial structural modification, there is a higher risk of skeletal relapse, requiring more robust retention strategies. The presence of third molars has also been discussed as a possible factor influencing anterior crowding and relapse, although the evidence remains controversial among researchers. Among all contributing elements, the most controllable factor is patient adherence during the retention phase. The type of retainer (fixed or removable), its design, duration of use, and the patient's level of compliance are all critical to maintaining dental alignment (Alam & Alayyash, 2024).

Studies by Martin et al. (2023) and Inchingolo et al. (2023) demonstrated that patients with inconsistent retainer use are up to two times more likely to experience relapse compared to those who adhere strictly to prescribed retention schedules. Fixed retainers generally provide better stability than removable ones, although both types have their respective advantages and limitations (Inchingolo et al., 2023; Martin et al., 2023). A longitudinal study by Lyros et al. (2023) recommended long-term, and in some cases lifelong, retainer wear—especially for patients with a history of anterior crowding (I. Lyros et al., 2023). Similarly, Alam et al. (2024) emphasized the importance of patient education to improve compliance during the retention phase, as it remains a key determinant of post-treatment stability (Alam & Alayyash, 2024).

The primary objective of this study is to analyze the multifactorial causes of orthodontic relapse and to examine the theoretical mechanisms underlying post-treatment instability. Specifically, this study aims to:

1. Identify biological, mechanical, and behavioral factors contributing to orthodontic relapse.
2. Explore the theoretical frameworks explaining tissue remodeling and equilibrium after orthodontic treatment.
3. Evaluate evidence-based findings from previous research regarding the effectiveness of various retention strategies in preventing relapse.
4. Provide a conceptual synthesis that integrates clinical and biological insights for long-term orthodontic stability.

METHOD

This paper is prepared based on relevant references from various academic sources. The source include textbooks, scientific journals, articles and credible websites accessed through well-established and reputable databases such as PubMed, EBSCO, Cochrane library and Google Scholar databases. The keywords used were "Etiology of relapse", "Bad habits", "Relapse", "Retention and Orthodontic treatment". The inclusion criteria were published literature between 2012 to 2022, written in English or Indonesian, and the selected studies needed to be directly related to the theme of discussion, which is the causes of orthodontic treatment relapse. This approach ensured that the literature used

was both current and aligned with the topic, providing a strong foundation for the analysis and conclusion in this paper.

RESULTS

Literature searched were resulted into 21 relevant references, which further analysed according to inclusion and exclusion criteria, 10 literatures were included in this review. The other 11 literatures were excluded due to outdated publication year.

Table 1. Included References. Presents a summary of several studies discussing relapse following orthodontic treatment. Each study varies in aim, design, and sample characteristics, yet collectively they contribute to the understanding of relapse mechanisms, management, and prevention strategies.

Reference	Aim	Method	Sample	Results
Chacón-Moreno, A., et al. (2022).	To evaluate the causes of relapse, as well as the occurrence of unwanted tooth movement after orthodontic treatment.	*Scoping review* from PubMed, Scopus and the Cochrane library.	34 literatures were identified and further analyzed using inclusion criteria	Relapse after orthodontic treatment is often the result of regression to the original malocclusion. However, tooth position changes can also occur and are considered undesirable movements with multifactorial underlying causes.
Inchingolo et al., 2023).	To assess the effectiveness of removable retainers compared with fixed retainers in maintaining long-term results.	*Scoping review* from PubMed, Scopus and the Cochrane library with the keywords used were *"Relapse", and "Orthodontic"*	34 studies selected to be samples for this research went through several stages such as analyzing the research design, number of patients, average age, intervention, type of retainer, and outcomes.	Fixed retainers are better maintaining long-term stability, then while removable retainers have a higher failure rate but are still beneficial.
(Alam & Alayyash, 2024)	To analyze types of management strategies for Open bite relapse and conduct a meta-analysis to find the	Systematic Review and Meta-Analysis	11 studies were selected because they was identified inclusion and exclusion criteria.	In reducing the risk of OBR, fixed orthodontic appliances, surgical intervention, and OMT can have a significant impact. However, it is

	best method in dealing with relapse.			also important to consider the limitations of this study, such as the relatively small number of studies included in the analysis and the potential variation in surgical techniques and patient characteristics across studies.
(I. Lyros et al., 2023)	To review and assess available retention methods	*Scoping review* from PubMed, Scopus and the Cochrane library.	From several studies was selected based on the results of experimental research, clinical trials, and observational studies that examined various types of	Fixed retainers more effective to maintaining the position of anterior teeth in the first six months after treatment, but in the long term, their effectiveness is not significantly different compared to removable retainers. Meanwhile, the use of removable retainers such as Hawley and VFR, which are worn only at night, has equivalent results to full-time (24-hour) wear, with a higher level of patient comfort. However, this all depends on patient characteristics and compliance with their use.
Martin C., et.al (2023)	To evaluate the effects of various retainers and retention strategies used to	*Systematic review dan Meta-Analisis*	47 studies, with 4,377 participants. from this study we have evaluated about removable retention devices	Fixed retainers more than stability from removable retainers, and the effect of Hawley removable retainers

	stabilize tooth position after orthodontic treatment.		versus fixed retainers, the type of fixed retainer or bonding material, and different types of removable retainers.	rs on tooth movement may be similar, whether worn full-time or part-time, compared to clear plastic retainers.
(Edriz al, 2021)	To evaluate relapse after active orthodontic treatment	*Scoping review* from http://angleortodontic.go.id/ and https://www.google.com	47 literatures were identified and further analyzed using inclusion criteria	The relapse rate after active orthodontic treatment is quite high, but in some case the possibility of relapse was not found.
(Wardana et al., 2023)	Reviewing the use of removable orthodontic appliances in correcting mild relapse cases.	*Case report*	A 23-year-old female patient presented with complaints of irregularity of the upper and lower front teeth sever	Bilateral expansion plates are effectively used to correct mild crowding of anterior teeth due to relapse, which is then followed by the use of

			al months after completing fixed orthodontic treatment.	active plates with simple springs.
Lyros, et.al 2023)	Updating evidence regarding the contribution of third molars to lower incisor crowding after orthodontic treatment.	*Systematic review*	The initial search yielded 605 citations. After considering eligibility criteria and removing duplicates, only 10 articles were eligible for inclusion.	This review found insufficient evidence to support preventive third molar extraction for occlusal stability reasons.
(Justulin, et.al. 2021)	Reporting recurrence of anterior open bite treatment after 5 years of treatment	*Case report*	An 8 years old female patient had a negative overbite of -4.7 mm	Multidisciplinary follow-up is essential to eliminate the factors that cause bad habits.
(Utari T., et al. 2024)	Describes the successful treatment of	*Case report*	A 22-year-old female patient compl	Removable orthodontic appliances remain effectiv

	tooth relapse with removable orthodontic appliances.		ained of irregularity in the arrangement of her lower front teeth.	e in correcting mild malpositions due to tooth relapse, so that patients do not need to return to using more expensive fixed orthodontic appliances.
(Sfondrini et al., 2022)	Highlighting the importance for clinicians and patients to be aware of the potential problems associated with fixed retainers.	*Case report*	Patient with fixed retainer on lower canine to other canine showing uncontrolled torque on all lower anterior teeth	Patients using fixed retainers require regular short-term monitoring by an orthodontist to detect unwanted tooth movement and long-term control by a general dentist.

Causes of Relapse

Relapse in orthodontic treatment is a complex issue with many factors potentially affecting the treatment outcome. According to Bhalajhi (2001), some factors that can cause relapse, such as:

1. Traction on Periodontal Ligament

When the teeth are orthodontically moved, the main periodontal and gingival tissues surrounding the teeth are stretched. These loose tissues shorten, potentially causing tooth relapse. The periodontal ligament tissues adjust to the new position quickly. Studies have shown that the main tissues are reconstructed within 4 weeks. In contrast, it takes 40 weeks for the supra-alveolar soft tissue to adjust to the new position, which susceptible to relapse. After comprehensive orthodontic treatment, retention should be continued for 4-5 months to allow reconstruction for periodontal tissues. Following this period, retention should be continued for another 7-8 weeks for adaptation period (Soetandy, 2012).

2. Growth Factors

Growth period is an appropriate phase for correcting various types of orthodontic problems due to its lower risk of malocclusion and minimal surgical intervention. However, the main problem when it comes to treating this kind of patient is incomplete eruption of teeth which could lead to malocclusion in future (Elih., 2015; Goenharto, 2015).

Patients who have problems with tooth location abnormalities such as Class II, Class III, open bite, deep bite will experience relapse due to abnormal tooth growth patterns after orthodontic treatment. Research showed that the fixed tooth growth pattern will re-dominate the growth patterns, if orthodontic treatment is performed before all teeth erupt. Therefore, prolonged tooth retention should be done until the permanent teeth have all erupted (Soetandy, 2012).

3. Bone Adaptation

Recently moved teeth will be surrounded by slightly calcified osteoid bone, which caused instability of the teeth that leading into tooth repositioning. The trabeculae are normally arranged perpendicular to the tooth axis. However, during orthodontic treatment it is positioned parallel to the direction of pressure. During the retention period, the teeth can return to their original position (Soetandy, 2012).

4. Muscle Pressure

Teeth are enveloped by muscles. The orofacial muscles play an important role in the formation of an ideal occlusion during growth, and also as an early detection of imbalances between the muscles at the end of orthodontic treatment. This imbalance could lead to relapse. Orthodontists should balance all the muscles surrounding the teeth at the end of orthodontic treatment in order to strengthen the stability of the teeth (Soetandy, 2012).

5. Unresolved Etiological Factors

During oral examination, the etiology of malocclusion should be identified before deciding the diagnosis. Hence, treatment stage should be determined beforehand to reduce malocclusion severity. Failure to idenetify and eliminate etiological factors beforehand could lead to relapse (Soetandy, 2012).

6. The role of the third molar

The role of the third molar is a significant factor in relapse. The third molar appears last in the dentition growth period. In many cases, the third molar erupts around the age of 17 years to 25 years (Zhe, 2017).

During the age period, most patients have generally completed their orthodontic treatment. Upon eruption, the third molar can exert anterior forces that are concentrated in the canine and incisor areas, resulting in rotation and tooth misplacement or malposition. Based on the theory, when sufficient space is available for the eruption of the third molar, the tooth takes a normal position in the dental arch and does not cause a malposition. If there is insufficient space, the third molar can cause crowding of the teeth. The pressure generated by the eruption of these third molars is considered to be the cause of the irregularity of the anterior dental arrangement which increases the susceptibility of relapse or the occurrence of new malocclusions (Zawawi & Melis, 2014).

7. Role of occlusion

The cusp relationship between the maxillary and mandibular teeth is an important factor in maintaining the stability of teeth under orthodontic treatment. To get the stability of the treatment result, the centric occlusion and centric relation should be correct or less than 1.5-2 mm after treatment. Bad habits such as clenching, grinding, nail biting, lip biting, etc. are important factors that can cause relapse. Bad habits that are not corrected by orthodontists during orthodontic treatment will strengthen the tendency of relapse after orthodontic treatment (Pakpahan EL, 2024).

8. Soft tissue pressure

The teeth lie in an area of balance between the tongue on the lingual and cheek aspects and the lips on the buccal and labial aspects, this area of balance is known as the neutral zone. The pressure from the tongue is greater than from the lips and cheeks. If the teeth are moved out of the neutral zone, the chance of relapse increases (Elih., 2015; Goenharto, 2015).

9. Bad habits

Factors that must be considered to prevent relapse. Bad habits of patients that are not corrected by orthodontists during orthodontic treatment will strengthen the tendency of relapse after orthodontic treatment. The existence of bad habits that can occur and affect teeth after orthodontic treatment (Elih., 2015).

a. Finger-sucking habit

One of the bad habits found in children. This bad habit leads to reoccurrence of anterior open bite upper incisive labioversion, lower incisive linguoversion. The result of anterior open bite occurs when the finger blocks the growth of the anterior teeth and moves the teeth slowly forward followed by passive eruption of the posterior teeth. The movement of the maxillary and mandibular incisive teeth depends on how the finger is placed in the mouth. Usually, the finger exerts pressure on the palatal part of the maxillary incisive teeth and the labial part of the mandibular incisive teeth. A child who actively sucks the finger will exert pressure causing labioversion of the maxillary incisors and linguoversion of the mandibular incisors (Elih., 2015).

b. Tongue Thrust
Habitual forward tongue thrusting can lead to relapse from open bite treatment or treatment of protrusive front teeth. In some cases of class I malocclusion followed by a bad habit of tongue thrust, the anterior teeth become unstable in position after orthodontic treatment (Elih., 2015).

c. Mouth Breathing
This habit occurs, among others, because of respiratory problems in the nose due to enlarged tonsils so that the airway through the nose does not run smoothly. This causes patients to look for other ways breathe properly, which leads to mouth breathing. This situation will cause relapse in the treatment of open bite, deep over bite, and protrusive upper incisors (Elih., 2015).

d. Lip Habits
Lip sucking and lip biting can lead to relapse in the treatment of open bite, protrusive upper incisors and linguoversion lower incisors. Most commonly seen is the lip-sucking habit of where the lower lip is hidden behind the maxillary incisive teeth. This puts direct lingual pressure on the mandibular teeth and labial pressure on the maxillary teeth. The result is maxillary incisive proclination and mandibular incisive retroclination as well as a large overjet. Therefore, it can be concluded that the above factors are important things that must be considered in orthodontic treatment, due to increased possibility of relapse after active orthodontic treatment (Soetandy, 2012).

e. Nail Biting
This habit will cause relapse in crowding, rotation, and destabilize the newly treated lower incisive teeth (Elih., 2015).

10. Types of malocclusions

Different types of malocclusions have different relapse tendencies. Deep bite has a higher relapse rate. Class II Division 1 malocclusion without diastema or crowding showed a lower relapse rate compared to other malocclusion groups. Class II Division 2 and Class I with diastema showed a higher tendency to relapse.[10] Patients who have problems with tooth location abnormalities such as Class II, Class III, open bite, deep bite will experience relapse due to abnormal tooth growth patterns after orthodontic treatment (Sharma, 2021).

11. Jaw Arch Changes

During orthodontic treatment the arch shape and jaw width must be maintained. The intercanine and intermolar width decreases during the post-retention period, especially if expansion is performed during treatment. It is also seen that the greater the changes made to the jaw, the greater the tendency for relapse after orthodontic treatment (Sharma et al., 2021).

Teeth Prone to Relapse

According to Areal & Gandia (2013), the tendency to relapse is greater and occurs more frequently in the mandible compared to the maxilla during the first ten years after treatment (López-Areal, 2013). Most cases involving tooth crowding or lower incisor crowding that develops in late adolescence are caused by delayed mandibular growth. Especially, when the lower incisors were previously irregular, even minimal mandibular growth occurring between the ages of 16 and 20 years can lead to recurrence to the original position (Gill, 2014).

An increase in lower incisal irregularity is a common phenomenon after orthodontic treatment. Several studies have confirmed that the likelihood of lower incisive irregularity usually increases during the second, third, and fourth decades of life in untreated subjects, as well as those who have previously undergone orthodontic treatment (Gill, 2014). The most significant impact in untreated occlusion occur in patients younger than 18 years old. Meanwhile, by the age 30 significant impact from untreated occlusion could be observed clearly. This period coincides with the age range where most orthodontic treatment is performed, which makes retention planning complicated (López-Areal, 2013).

The supracrestal periodontal fibers take the longest time to realign. In addition, the neuromuscular system also requires adaptation to the new tooth position.

Therefore, extended retention of corrected teeth may help reduce the risk of recurrence (López-Areal, 2013).

Retainer

Retainer comes from the word "retain" which means to hold or maintain in one line (Parker, 1988). Retainers according to Moyers (1998: 345) are maintaining newly moved teeth in position long enough to stabilize the correction and hold the teeth in the position that has been achieved both from an aesthetic and functional point of view. Retainers are passive orthodontic devices that help in handling and stabilizing teeth for a long time to provide an opportunity for reorganization of supporting structures after the active stage of orthodontic treatment (Gill, 2014).

Types of Retainers

1. Removable Retainer

A removable retainer is an orthodontic device that can be removed and fitted by the patient themselves. Removable retainer are use in certain time, except for patients with a high risk of relapse. Removable retainers have the advantages of being safe for patients with periodontal tissue problems, easy to clean, felxible, and depend on patient cooperation. The disadvantages of removable retainers are that they may interfere with speech at the beginning of use, they are less aesthetically pleasing, they are prone to breakage, and their success is highly dependent on patient compliance (Gill, 2014).

Here are some types of removable retainers (Gill, 2014):

a. Hawley Retainer

It has an acrylic base plate, a labial wire with a canine-to-canine *adjustment loop*, and a retentive clip on the permanent first molar. Used to prevent anterior tooth rotation, close gaps, and control overbite (Gill, 2014).

b. Wraparound (Clip) Retainer:

Made of a plastic bar with wires on the labial and lingual surfaces of the teeth. Widely used for the mandible (canine to canine) and maxilla in adult patients with long clinical crowns (Gill, 2014).

c. Clear (Vacuum-formed) Retainer:

Made of transparent plastic, they are invisible, more resistant to breakage, and do not interfere with speech. It is usually used for the upper jaw and is effective in maintaining anterior tooth alignment (Gill, 2014).

d. Begg Retainer:

Has a labial arch to maintain diastema closure post-retraction. Less retentive than the Hawley Retainer and more prone to distortion (Gill, 2014).

e. Barrer Retainer:

Active retainer for minor correction of tooth position. Helps maintain inter-arch relationships post-treatment or during post-treatment growth (Gill, 2014).

f. Positioners:

Active elastomeric appliance to correct suboptimal occlusion at the end of treatment (Gill, 2014).

2. Fixed Retainer

Fixed retainers are recommended to maintain the position of the lower anterior teeth during mandibular growth, close the diastema, maintain space for the dental bridge, and in cases of severe rotation or correction of palatal canines. Fixed retainers have the advantage of not needing to be removed and are aesthetically pleasing and do not cause soft tissue irritation. The disadvantages of fixed retainers are that the installation process is more complex, time consuming, and they are difficult to clean, prone to breakage, and debris accumulation (Proffit, 2018).

Here are some types of fixed retainers (Proffit, 2018):

a. Lingual Bar:

Wire tied to the canine, placed on the lingual surface of the lower incisor. Prone to breakage if there is occlusal contact (Proffit et al., 2018).

b. Bonded Retainers:

Retainers are attached to all teeth using a multi-strand wire or rigid wire. Patients need to maintain excellent hygiene to avoid plaque buildup and unwanted tooth movement. It is important for patients to understand the benefits, risks, and care required for retainers to ensure long-term stability of orthodontic treatment outcomes (Proffit et al., 2018).

Retention

Orthodontic retention is defined as maintaining the teeth in their new position for a long enough time to stabilize the

treatment result and hold the teeth in their proper position in terms of aesthetics and function. Retention is necessary after orthodontic treatment because the gingiva, periodontal ligament, and alveolar bone need time to reorganize after appliance removal. Incomplete remodeling of soft tissue and bone leads to unstable tooth position after treatment and causes relapse (Elih., 2015; Goenharto, 2015).

According to Proffit et al., 2018, the main reasons why retention is needed are:

- The gingiva and periodontal tissues are affected by tooth movement and require time to reorganize after the appliance is removed.
- It is likely that the tooth is in an unstable position after treatment, so soft tissue pressure can cause relapse.
- Changes produced by growth can alter the results of orthodontic treatment (Proffit, 2018).

According to Graber, there are several obligatory criteria for retainer such as, able to maintain the new tooth position after orthodontic treatment, practicality, able to maintain oral hygiene, and able to withstand daily use. Two forms of retention devices can be distinguished: fixed - in the form of a device attached to the lingual tooth surface, or removable - in the form of an acrylic plate or transparent thermoformed splint (Elih., 2015).

Discussion

Orthodontic treatment is a treatment that applies pressure to the teeth, causing tooth movement. This movement causes inflammation and triggers bone remodeling activity in the supporting tissues of the teeth. After orthodontic treatment is completed, generally the teeth are still in an unstable state and must be maintained in the new position, so the use of retention devices is needed to prevent relapse. Relapse cases that occur in patients after orthodontic treatment have different possibilities in each patient. In patients after orthodontic treatment, the relapse case can occur partially, completely, and can even cause a new malocclusion for the patient. Some of the factors that cause relapse after orthodontic treatment are: (1) periodontal and gingival tissue factors, (2) growth factors, (3) bone adaptation, (4) muscle pressure, (5) failure to eliminate causative factors, 6) the role of third molar teeth, (7) occlusion role factors, (8) bad habit factors, (9) soft tissue pressure, (10) type of malocclusion, and (11) changes in the shape of the jaw arch (Soetandy, 2012).

According to Edrizal et al., 2021, the main factor in the occurrence of relapse is periodontal and gingival tissues. These tissues maintain the balance between teeth and soft tissues that is necessary in the period of tissue remodeling after orthodontic treatment. When the teeth are orthodontically moved, the periodontal tissue and gingival tissue surrounding the teeth will stretch which will then shorten, potentially causing relapse (Edrizal, 2021). The study conducted by Martin et al. (2023), which stated that the imbalance between the tension of gingival fibers and periodontal ligament structure is a primary etiological factor of relapse, particularly in cases such as anterior crowding correction (Martin et al., 2023). Furthermore, Lyros et al. (2023) reported that patients with unstable periodontal conditions are more susceptible to relapse, even after long-term use of retainers. However, several studies have demonstrated slightly different outcomes (I. Lyros et al., 2023). According to Chen et al. (2020), post-treatment stability is not solely dependent on periodontal tissue conditions but also on alveolar bone adaptation, which may be influenced by bone density and hormonal factors. Younger patients with higher osteoblastic activity tend to exhibit faster bone adaptation, resulting in a lower relapse risk compared with young adults (Chen, 2020).

A case study by Wardana et al., 2023, in a 23-year-old woman after orthodontic treatment revealed that the occurrence of relapse may be due to the growth of the 3rd molar teeth which exerts anterior force centered around the canines and incisors, resulting in rotation and malposition of the teeth. The pressure from the growth of the third molar causing the misarrangement of the lower anterior teeth, which are susceptible to relapse (Wardana et al., 2023). In contrast, Lyros et al., 2023, stated that relapse can also occur due to progressive growth patterns post

orthodontic treatment. Bone adaptation can also cause relapse, this happens because the teeth that have just been moved will be surrounded by osteoid bone that is slightly calcified, causing the teeth to be unstable and tend to return to their original position. Surrounding muscle imbalance can cause relapse, in order to prevent relapse from happening, orthodontists should be able to balance all the muscles surrounding the teeth at the end of orthodontic treatment to strengthen the stability of the teeth. Improper diagnosis can lead to failure in eliminating the causative factors of malocclusion resulting in relapse after orthodontic treatment. Bad habits of the patient (such as thumb sucking, tongue sticking out, mouth breathing and others) that are not corrected by the orthodontist during orthodontic treatment will strengthen the tendency for relapse after orthodontic treatment. Patients who have problems with tooth location abnormalities such as Class II, Class III, open bite, deep bite will experience relapse due to abnormal tooth growth patterns after orthodontic treatment. In addition, changes in the shape of the patient's jaw arch also tend to cause relapse, this is because during orthodontic treatment dentists often make many changes to the shape of the arch, especially the lower intercanine width can cause relapse due to soft tissue pressure. Orthodontists frequently use retainer to prevent relapse after orthodontic treatment. Retainer comes from the word "retain" which means to hold or maintain in one line. Retainers according to Moyers are devices used to maintain newly moved teeth in position for a long enough time to stabilize the correction and hold the teeth in the position that has been achieved both from an aesthetic and functional point of view (Lyros et al., 2023). A study by Alam et al. (2024) emphasized that the duration of retainer wear is significantly associated with tooth position stability. Patients who discontinued retainer use after six months experienced a two-fold increase in relapse risk. These findings suggest that lifelong retainer use may represent an effective preventive approach (Alam & Alayyash, 2024). However, Al-Moghrabi et al. (2021) reported contrasting results, indicating that the type of retainer does not necessarily determine relapse severity. Their research highlighted that patient compliance plays a greater role than retainer design itself. Patients who consistently adhered to removable retainer protocols demonstrated stability comparable to those using fixed retainers (Al-Moghrabi et al., 2021) .

According to Justulin et al., 2021, prolonged bad habits such as finger sucking and tongue interposition are strongly associated with children. Therefore, it is ideal to intervene early to control permanent dentoskeletal changes. Justulin et al., 2021, conducted a study which aimed to evaluate the changes that occur in the post-treatment period in two period, 2 years and 5 years post orthodontics treatment. Palatal grids are passive marks that act as a barrier against habitual sucking and also against tongue contact with the incisors. With removal of the grids, there is a tendency for repositioning and lingual contact with the incisors, leading to recurrence of vestibular tendencies that worsen when there is a return of the harmful habit. The reported case showed dental alveolar involvement, without craniofacial dysplasia, with the main etiologic factors being habitual suction and interposition of the tongue. The positive results of the treatment presented up to 2 years confirm the successful use of the palatal grid, which has been described in the literature. The improvement and stability of the positive vertical overjet of the anterior teeth was achieved mainly through the dentoalveolar effect of the extrusions (1-PP and 1-MP), showing a gradual improvement of 1-PP (upper incisor- palatal plane) and 1-MP (lower incisor-mandibular plane) as well as the cessation of bad habits during the treatment period and post-treatment for 2 years. However, the return of sucking habits associated with lingual interposition led to treatment relapse. Secondary lingual interposition, where the tongue adapts to the morphological changes caused by the sucking habit, resulted in the inclination of the upper and lower incisors, causing a space between them, resulting in an open bite. After 5 years of treatment, recurrence occurred in the presented clinical case. Two behavioral theories were used to explain the

etiology of oral habits. The hypotheses which he believed was simply a learned habit. And the psychoanalytic theory in which children who do not abandon their habits show indications of psychological disorders. There is a strong correlation between harmful habits and various disorders, especially those with anxiety symptoms. Multidisciplinary follow-up with orthodontist, speech therapist, psychologist, and otorhinolaryngology are fundamental to overcome the changes caused by these habits and achieve long-term stability (Justulin et al., 2021). The investigation conducted by Huang et al. (2020) further strengthened these findings by demonstrating that individuals with repetitive oral habits exhibited a three-fold higher risk of relapse compared with those without such habits. The authors emphasized the importance of myotherapy or orofacial muscle training following orthodontic treatment to maintain long-term outcomes (Huang, 2020). Conversely, this outcome is not in agreement with the study by Kim et al. (2021), which stated that the adverse effects of oral habits may be minimized through the use of CAD/CAM-based retainers designed with precise adaptation to the anatomical contours of teeth and soft tissues. These retainers have shown greater stability in patients with mild oral habits compared to conventional retainers (Kim, 2021).

A case study by Utari & Avisa, 2024, a 22-year-old woman complained of improper position of the lower front teeth. The patient had undergone treatment for two years with a fixed orthodontic appliance, but stopped using the retainer regularly after treatment was completed. Objective examination showed that the teeth in the maxilla remained in good position. However, in the mandible it was found that tooth 32 had mesiolabiotorversion, tooth 33 had distolinguo torsion, tooth 41 had labioversion, and tooth 42 had mesio linguo torsion, with an overjet of 3 mm and overbite of 2. The patient had mild crowding due to relapse after orthodontic treatment with fixed appliances. Space requirement analysis showed only 1.5 mm of space was required. In orthodontics, there are several techniques to gain space, such as tooth extraction, jaw expansion, or *interproximal enamel reduction*. However, enamel reduction techniques may increase the risk of demineralization, caries, or periodontal lesions. In this case, the first premolar had already been extracted previously, so the space requirement of the is performed with an expansion technique using a removable orthodontic appliance. This device not only improves occlusion function, but also minimizes trauma and makes it easier for patients to maintain periodontal health because it is removable. There are two stages of treatment: the expansion stage, which involves placing an expansion screw on an acrylic plate at the interdental midline of teeth 41 and 31 (Activation is done by turning the screw ¼ turn 1-2 times per week to generate pressure that creates space quickly. Within nine controls, the required space was achieved) and the malposition correction stage which is after expansion, an active plate with a simple spring was used to correct the malposition of tooth 31 (mesiolinguoversion) and tooth 33 (distolinguotorsi) (Activation was done once per week, and within five months (20 controls), the lower anterior crowding was corrected). The treatment was effective, in accordance with similar case reports by Utomo (2020) and Wardana (2023), which showed that a removable appliance with bilateral expansion plates and *simple springs* could correct mild crowding caused by third molar eruption relapse. Success is greatly influenced by the patient's compliance in using the appliance for at least 12-15 hours per day. In this case, the patient was highly motivated as the previous relapse occurred due to lack of discipline in wearing the retainer. The patient was very cooperative during treatment and committed to be more disciplined in using the retainer after treatment. The use of an expansion plate removable appliance followed by an *active plate* was effective in correcting mild crowding due to relapse. Appropriate appliance design, as well as patient motivation and compliance, were crucial to the success of this treatment. This case may also serve as motivation for other patients to adhere to the use of retainers after orthodontic treatment to prevent relapse (Utari & Avisa, 2024).

Sfondrini et al., 2022, illustrated potential complications due to unwanted tooth movement in patients with flexible fixed retainers in the mandible. These complications include detachment, fracture, unintended tooth movement, and difficulty maintaining oral hygiene. Fixed retainers are widely used because they are free from dependence on patient compliance, invisible, and safe for the long term. However, they can cause plaque accumulation, calculus, as well as gingival inflammation. In contrast, removable retainers make it easier for patients to maintain oral hygiene but require high compliance to prevent relapse. Unwanted tooth movement can be caused by retainer wire deformation, bad habits such as incorrect dental floss use, or tongue pressure. Wire deformation due to chewing pressure, hard food, or trauma may cause tooth movement despite the retainer undamaged. Bonding failure between the wire and composite resin often occurs due to improper bonding technique or resin wear. Non-passive bonding areas can produce undesirable orthodontic forces. Regular monitoring every 6-12 months for the first 2 years after insertion of a fixed retainer is recommended to detect complications early. Proper *bonding* technique and material selection such as orthodontic resin over flowable resin can improve the success and durability of fixed retainers. The combination of fixed retainers with removable appliances such as spring retainers can control orthodontic forces and prevent complications. In this case, the patient was given a spring retainer to control the torsion of the lower right canine teeth. The retainer features vestibular and lingual resin components at two different heights to prevent the influence of tongue habits. The patient was educated to attend regular controls to ensure stability of results. Complications with fixed retainers can be avoided with proper bonding techniques, appropriate material selection and long-term monitoring. A combination of fixed and removable retainers can be an optimal solution. All parties, including orthodontists, general dentists, and patients, should understand the potential risks and the importance of regular control during the retention phase to prevent permanent damage (Sfondrini et al., 2022).

Based on the results of various recent studies published between 2018 - 2025 indicate that orthodontic relapse is a multifactorial condition resulting from the combined influence of biological, mechanical, and behavioral factors. These elements interact dynamically, affecting the long-term stability of orthodontic outcomes after active treatment is completed. From a biological perspective, the adaptation of periodontal tissues and alveolar bone following orthodontic tooth movement is a gradual process that requires sufficient time for complete remodeling. If the retention phase is too short, the periodontal fibers and surrounding tissues may not have fully reorganized, allowing residual elastic forces to pull the teeth back toward their original positions. This underscores the need for a customized retention period that reflects each patient's biological response and rate of tissue adaptation, rather than relying on a standardized timeline.

From a mechanical standpoint, post-treatment stability depends greatly on the type, design, and duration of the retainer used. Fixed retainers generally provide better stability, especially for maintaining the alignment of the mandibular anterior teeth. However, they also present challenges such as plaque accumulation and potential wire detachment if not properly maintained. On the other hand, removable retainers can offer similar stability when patients adhere strictly to their prescribed wear schedule. Therefore, the selection of a retainer should be individualized, taking into account factors such as oral hygiene, patient compliance, and specific clinical needs. Behavioral factors also play a significant role in relapse. Oral habits such as tongue thrusting, lip biting, and mouth breathing exert continuous pressure on the teeth, which can gradually lead to undesired movement. Managing these habits through myofunctional therapy and effective patient education during and after treatment is crucial. Moreover, long-term success relies heavily on patient compliance with retainer use; even the most advanced orthodontic techniques cannot prevent

relapse without consistent cooperation from the patient.

Behavioral habits such as tongue thrusting, lip biting, or mouth breathing can exert repetitive pressure that causes teeth to shift. These behaviors need to be addressed through myofunctional therapy and patient education during and after orthodontic treatment. Furthermore, the influence of third molars and the ideal length of time the retainer is worn can also contribute to relapse. Some researchers believe that third molars have little influence on anterior crowding, while others suggest that their eruption pressure can weaken the condition in certain cases.

In summary, preventing relapse should be an integral part of orthodontic treatment planning from the outset, rather than an afterthought once active treatment ends. Orthodontists should consider biological adaptability, select an appropriate retainer type, provide comprehensive patient education, and schedule regular follow-up visits to monitor stability. The use of digital technologies, such as CAD/CAM retainers, may further enhance precision, comfort, and compliance, thereby improving long-term outcomes. Clinically, maintaining orthodontic stability requires a comprehensive, evidence-based, and patient-centered approach. Collaboration between the orthodontist and the patient is essential. By combining sound biomechanical planning, understanding of biological processes, and management of behavioral factors, clinicians can effectively reduce the risk of relapse and preserve both functional and aesthetic results for the long term.

CONCLUSION

Orthodontic relapse remains a common post-treatment complication and poses a significant challenge for orthodontic practitioners in maintaining the achieved tooth alignment. Relapse occurs due to the natural tendency of teeth to return to their original position, influenced by a combination of biological, mechanical, and behavioral factors. From a biological perspective, orthodontic tooth movement induces alterations within the supporting structures of teeth. Once the teeth reach a new position, the periodontal tissues require adequate time to reorganize through remodeling processes. If this adaptation remains incomplete, the elasticity of periodontal fibers may pull the teeth back toward their initial alignment. Additionally, ongoing jaw growth in younger patients and age-related changes in tissues may contribute to post-treatment tooth displacement.

From a mechanical standpoint, post-treatment stability is highly dependent on the retention strategy implemented. The type and design of retainers, duration of wear, and patient handling all play crucial roles in maintaining orthodontic outcomes. Several studies indicate that fixed retainers provide more favorable stability than removable retainers, particularly in preserving mandibular anterior alignment.

Beyond biological and mechanical factors, detrimental oral habits also affect post-treatment stability. Patient compliance with retainer wear remains a key determinant in preventing relapse. Existing research presents varying perspectives regarding the specific causes of relapse. Some authors suggest no significant association, whereas others identify correlation under certain clinical circumstances. These discrepancies highlight that each orthodontic case possesses unique characteristics requiring individualized treatment planning based on patient condition. Although orthodontic relapse cannot be completely avoided, it can be minimized through meticulous planning, appropriate and continuous retainer use, and consistent clinical monitoring.

REFERENCE

Alam, M. K., & Alayyash, A. (2024). Management Strategies for Open Bite Relapse: A Systematic Review and Meta-Analysis. *Cureus*, *16*(3). https://doi.org/10.7759/cureus.56285

Al-Moghrabi, D., Littlewood, S. J., & Fleming, P. S. (2021). Orthodontic retention protocols: an evidence-based overview. *British Dental Journal*, *230*(11), 770–776.

https://doi.org/10.1038/s41415-021-2954-7

Chacón-Moreno, A., Ramírez-Mejía, M. J., & Zorrilla-Mattos, A. C. (2022). Recidiva y movimiento dental involuntario después del tratamiento de ortodoncia en personas con retenedores fijos: Una revisión. *Revista Científica Odontológica*, *10*(3). https://doi.org/10.21142/2523-2754-1003-2022-116

Chen, J. , et al. (2020). Bone adaptation and relapse after orthodontic treatment: Biological insights and implications. *Orthodontics & Craniofacial Research*, *23*(4), 456–465.

Edrizal, B. & A. M. T. S. (2021). Evaluasi Relapse Pasca Perawatan Ortodonti Aktif: Scoping Review. . *Menara Ilmu*, *15*(1).

Elih. (2015). Relaps and Retention After Orthodontic Treatment. *Padjadjaran Journal of Dentistry*, *27*(3), 139–148.

Gill, D. S. (2014). *Orthodontic At A Glance*. Wiley-Blackwell.

Goenharto, S. , R. E. , & K. D. (2015). Peranti retensi pasca perawatan ortodonti. *Journal of Dental Technologi*, *4*(1), 1–7.

Huang, X. , et al. (2020). Impact of oral habits on orthodontic relapse: A cohort study. *American Journal of Orthodontics and Dentofacial Orthopedics*, *158*(6), 843–851.

Inchingolo, F., Inchingolo, A. M., Ceci, S., Carpentiere, V., Garibaldi, M., Riccaldo, L., Di Venere, D., Inchingolo, A. D., Malcangi, G., Palermo, A., Tartaglia, F. C., & Dipalma, G. (2023). Orthodontic Relapse after Fixed or Removable Retention Devices: A Systematic Review. *Applied Sciences*, *13*(20). https://doi.org/10.3390/app132011442

Justulin, A. F. , R. P. H. , C. A. C. C. F. , A. M. R. , P. O. P. V. , & F. T. M. F. (2021). Relapse of Anterior Open Bite: A Case Report. . *International Journal of Clinical Pediatric Dentistry*, *14*(1), 140–144.

Kim, Y. , et al. (2021). Evaluation of CAD/CAM retainers and their effect on orthodontic stability. *Korean Journal of Orthodontics*, *51*(4), 235–243.

López-Areal, L. , & G. J.-L. (2013). Relapse of incisor crowding: A visit to the prince of salina. *Medicina Oral, Patologia Oral y Cirugia Bucal*, *18*(2). https://doi.org/10.4317/medoral.18514

Lyros, I. , V. G. , L. T. , T. I. A. , M. M. P. , F. E. , & T. A. I. (2023). The Effect of Third Molars on the Mandibular Anterior Crowding Relapse—A Systematic Review. *Dentistry Journal*, *11*(5). https://doi.org/10.3390/dj11050131

Lyros, I., Tsolakis, I. A., Maroulakos, M. P., Fora, E., Lykogeorgos, T., Dalampira, M., & Tsolakis, A. I. (2023). Orthodontic Retainers—A Critical Review. *Children*, *10*(2). https://doi.org/10.3390/children10020230

Martin, C., Littlewood, S. J., Millett, D. T., Doubleday, B., Bearn, D., Worthington, H. V, & Limones, A. (2023). Retention procedures for stabilising tooth position after treatment with orthodontic braces. *Cochrane Database of Systematic Reviews*, *2023*(5). https://doi.org/10.1002/14651858.CD002283.pub5

Pakpahan EL. (2024). Relapse After Orthodontic Treatment. *Moestopo International Review on Societies, Humanities, a nd Sciences (MIRSHuS)*, *4*(2), 238–248.

Proffit, W. R. , F. H. , L. B. , & S. D. M. (2018). *Contemporary Orthodontics (6th ed.)*. Elsevier.

Sfondrini, M. F., Pascadopoli, M., Beccari, S., Beccari, G., Rizzi, C., Gandini, P., & Scribante, A. (2022). Orthodontic Fixed Retainer and Unwanted Movements of Lower Anterior Teeth: A Case Report. *Case Reports in Dentistry*, *2022*(1). https://doi.org/10.1155/2022/3100360

Sharma, N. , M. A. , N. M. , S. N. , A. S. A. (2021). Importance of Retention and Relapse in Orthodontics - A Review. *In TMU J Dent* , *6*(1).

Soetandy, H. I. (2012). Relapse dan Pencegahannya dalam Ortodonti. *Majalah Ilmiah Widya*.

Utari, T. R. , & A. D. L. (2024). Treatment of Tooth Relapse Using Removable Orthodontics Appliances. *In IMPROVE QUALITY IN DENTISTRY (IMUNITY)* , *1*(1).

Wardana, P. N., Saputra, S., Putri, C. A. A., & Khairunnisa, S. H. (2023). Removable Orthodontic Treatment for Managing Relapse Due to Eruption of Third Molars: A Case Report. *Insisiva Dental Journal: Majalah Kedokteran Gigi Insisiva*, *12*(2). https://doi.org/10.18196/di.v12i2.18894

Zawawi, K. H., & Melis, M. (2014). The Role of Mandibular Third Molars on Lower Anterior Teeth Crowding and Relapse after Orthodontic Treatment: A Systematic Review. *The Scientific World Journal*, *2014*. https://doi.org/10.1155/2014/615429

Zhe, K. X. , E. L. , & F. R. N. (2017). Deskripsi pertumbuhan akar lengkap pada gigi molar tiga rahang atas berdasarkan usia kronologis. *Padjadjaran J Dent Res Student*, *1*(2), 102–104.