International Journal of Community Medicine and Public Health
Najjar HE et al. Int J Community Med Public Health. 2023 Aug;10(8):2946-2950
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20232173

Review Article

Factors affecting retention and relapse in orthodontics

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Received: 28 June 2023
Accepted: 12 July 2023

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ABSTRACT

Orthodontic treatment aims to achieve stable and harmonious occlusion by correcting malocclusions and aligning teeth. However, the long-term success of orthodontic treatment relies heavily on the effectiveness of the retention phase. Retention involves maintaining the corrected tooth positions and preventing relapse, which refers to the tendency of teeth to return to their original malocclusion positions over time. The retention phase applied after treatment is important to obtain stable results. Various factors can influence the retention phase and contribute to relapse in orthodontics. Periodontium, soft tissue pressures, growth, and occlusion are among these factors affecting stability. Understanding these factors is crucial for orthodontists to design appropriate retention protocols and enhance treatment outcomes. To achieve successful long-term stability, orthodontists must comprehensively evaluate and address the factors during the retention phase. This review article will discuss factors that affect retention and relapse in orthodontics.

Keywords: Retention, Relapse, Orthodontics, Stability, Tooth movement

INTRODUCTION

Orthodontic treatment aims to correct malocclusions and achieve stable occlusion and alignment of the teeth. However, maintaining the achieved tooth positions over the long term, known as the retention phase, can be challenging. The success of orthodontic treatment depends heavily on effective retention protocols to prevent relapse. Orthodontic relapse is a common feature after effective orthodontic treatment.[1] According to reports, during the post-retention period, lower dental arch compensation of varied degrees took place in 70-90% of orthodontically treated patients, although the observed alterations in the upper dental arch were minor. Orthodontic relapse has been linked to a variety of factors, including the retention technique, patient compliance, age, and the ultimate occlusion following treatment. Crowding continues to worsen for ten to twenty years after retention, and relapse is common even

when premolar extractions are part of the orthodontic therapy.[1] Orthodontic relapse has a complicated and unknown aetiology. The periodontal ligament's elastic fibres have been theorised to play a role in the recurrence of affected teeth.[2] Relapse prevention is a significant and difficult issue in orthodontics that frequently necessitates long-term retention. Removable and permanent retainers are frequently used in retention techniques, with the latter having the advantage of requiring less patient compliance. The fixed retainers advised to use resin composite orthodontic adhesives to attach braided or solid metallic wires to enamel.[3] These resin-composite orthodontic adhesives are composed of a mixture of resin matrix and fillers, such as glass or ceramic particles.[4] The number of teeth bonded (all six anterior teeth or just the canines), the bonding substance (restorative resin composite or flowable orthodontic glue), the kind of wire (solid or multistranded), and the wire size vary depending on the bonding procedure. Fibre retainers provide the advantages of specially designed composite materials with a particular elasticity modulus, improved load bearing, excellent aesthetics, and formability.[5] The retention phase is a critical component of orthodontic treatment as it allows for the stabilization and consolidation of tooth movements. During this phase, other factors can influence the long-term stability of the achieved results. These factors can be categorized into biological, treatment-related, patient-related, and environmental factors. Understanding the factors that affect the retention phase and contribute to relapse is essential for orthodontists to tailor individualized retention protocols and optimize treatment outcomes. By addressing these factors, orthodontists can enhance the long-term stability of orthodontic results and achieve optimal oral health and aesthetics for their patients. In this review article, we will discuss these factors in detail.

LITERATURE SEARCH

This study is based on a comprehensive literature search conducted on May 17, 2023, in the PubMed, Medline, and Cochrane databases, utilizing the medical topic headings (MeSH) and a combination of all available related terms, according to the database. To prevent missing any possible research, a manual search for publications was conducted through Google Scholar, using the reference lists of the previously listed papers as a starting point. We looked for valuable information in papers that discussed the factors affecting retention and relapse in orthodontics. There were no restrictions on date, language, participant age, or type of publication.

DISCUSSION

Although most orthodontists monitor retention for the first 12 to 24 months after treatment, they frequently assume that the patient will be willing to monitor retention and any subsequent dental changes in the longer term. Orthodontic retention always requires a lifetime commitment from the patient. Therefore, effective communication between the orthodontist and patient is crucial so that, at the very least, all parties are fully informed of when any change in the patient's need to retain their braces is to take place and what may be necessary.[6]

Forces and factors that affect the post-treatment occlusion and retention

Forces from periodontal and gingival tissues

Orthodontic tooth movement affects the supporting periodontal and gingival tissues as well as the alveolar bone, all of which require time to rearrange following treatment.[7-10] The tension in the stretched periodontal fibres shows a tendency to revert to pre-treatment positions.[11] Alveolar bone may remodel within three to four months, and principal collagen fibres usually with gingival collagen fibres take as long as six months. It has been suggested, however, that these timelines may be shorter. More than 232 days are needed for the formation of the transseptal and free gingival elastic fibres, whose attachment to the dental arch is influenced by tooth position and direction throughout fibre development.[12] Elastic fibres, proteoglycans, and glycosaminoglycans have been observed to affect relapse more than persistent strain from periodontal collagen fibres. During tooth rotation, supra-alveolar fibres may not be tensed but still remain attached to the connective tissue as gingival tissues adapt, and factors other than their straightening may account for relapse, such as a rise in elasticity.[13] Although more frequent relapse has been noted in the positions of lower lateral incisors, canines, and second premolars, teeth located more posteriorly have also shown a greater relapse tendency. The periodontium continues to exert compressive force on the mandibular dentition after chewing, preserving tooth contacts, which leads to late lower labial segment crowding.[14]

Forces from soft tissues

Lying in a neutral zone of soft tissue balance between the lips, cheeks, and tongue, maintenance of tooth position is conditional on the response of an intact periodontium to resist stronger lingual than labial forces.[15] Orthodontic treatment should aim to position the teeth within a narrow zone, as movement, especially of the lower labial segment, markedly in a labial or lingual direction is prone to relapse unless justified in certain circumstances. Stability of lower incisor proclination may ensue in some class II cases where the lower incisors have been retroclined by a digit-sucking habit, lip trap, contact with the palate, or upper incisors, or where simultaneous mandibular surgical correction is used in class III.[16] With longer duration, resting rather than active, pressures during function have more influence on final tooth positions.[17] Nonetheless, the precise location and dimensions of the neutral zone remain unknown, as does the impact dentofacial ageing is likely to exert.

Occlusal forces

Considered to arise from the mesial inclination of teeth related to the occlusal plane, the anterior component of occlusal force may cross from one side of the arch to the other through tooth contacts, with the level of force and tightness of posterior mandibular interproximal contacts strongly correlated with mandibular dental irregularity.[17] The anterior component of occlusal force has also been utilized in functional appliance treatment, although lower pre-treatment maximal molar bite force and an obtuse gonial angle have been associated with greater relapse tendency.[18] Failure of the tongue to adapt to the new tooth position is important for post-treatment stability. In anterior or posterior crossbite-where the overbite or buccal interdigitation maintain correction, no or minimal long-term retention is necessary.[19]

Mixed dentition correction of anterior or posterior crossbite appears to become stable at two and three years, respectively.[20] Removable retention may be adequate following posterior crossbite correction, but comparisons in different age groups are lacking regarding the effectiveness or stability of correction.[21] For anterior crossbite due to maxillary retrusion, management with protraction facemask therapy before the age of ten years looks stable at three-and six-year follow-up (70% and 68%, respectively), and related to a clockwise rotation of the maxilla and mandible with no increase in lower facial height.[22] Overbite reduction may be unstable, with stability contingent on maintenance of lower labial segment alignment.[23] For stability, it has been suggested that the inter-incisal angle should approximate the average (135°), and the lower incisor should be positioned 0-2 mm forward of the upper incisor centroid.[24] Stronger evidence is required to confirm the latter assertion. Long-term stability appears to be affected principally by age at the start of treatment and technique used for correction, with greater success in early teens or adulthood using Ricketts' bio-progressive segmental mechanics, producing incisal intrusion rather than relative molar extrusion.[25] Good buccal interdigitation has been deemed important for post-treatment stability. With higher quality finishing, occlusal relationships have been found to improve during and post retention and even where slight occlusal deterioration occurred, the quality of occlusion remained effective.[17] While stability may be assisted by attainment of a class I molar relationship, it is not a guarantee, as growth changes may neutralize the changes. A post-normal molar relationship, however, may benefit growth and encourage retention of correction. Although a larger first molar contact area has been found in cases finished to a class I than to a class II relationship, this finding was insignificant. Unsurprisingly, therefore, class II cases treated with and without extraction of first premolars (that is, finished to a class II or class I molar relationship) demonstrated similar molar stability, but those treated with four premolar extractions exhibited greater molar relapse than those treated with extraction of upper first premolars only.[26] A greater molar position change during treatment appears to be more prone to relapse.[27] Occlusal reasons for overjet relapse have been associated with the magnitude of initial overjet, overbite, and inter-incisal angle, end-of-treatment overjet and incisor inclination changes out of retention, end of treatment, as well as post-retention retroclination of mandibular incisors.

Association was weak with overjet change during treatment.[28] Although links to simultaneous relapse of molar, premolar, and canine relationships exist, no association with the quality of the buccal segment relationship has been found.[28] Favourable downward and forward mandibular growth promotes stability. Anterior open bite: the magnitude of the pre-treatment open bite is not a guide to post-treatment stability.[17] While strategies to correct the anterior open bite in the developing dentition may be effective and more stable than non-extraction, evidence is limited in this regard.[29,30] Extraction and orthognathic treatment can be more effective and stable than either form of orthodontic treatment.[31] Evidence differs, however, as to whether overbite correction is more stable following bimaxillary surgery or osteotomy. Rotated upper anterior teeth often relapse into the pre-treatment pattern.[31] Significant associations have been found for overall upper and lower incisor misalignment and for the amount and direction of movement between opposing inter-arch central incisors. However, no association was identified for the overall amount of incisor rotations in both arches or between maxillary incisor palatal shape and the pattern of lower incisor irregularity.[17] A change in overjet has been noted to occur less frequently than lower incisor crowding. A minor possibility of change exists with respect to maxillary incisor stability if retained initially with a bonded retainer for one year. Corrected maxillary incisor misalignment has been observed for almost 25 years. Space closure of previously spaced mandibular arches has been noted to remain even ten years post-retention following non-extraction fixed appliance treatment, whether it coincided with progressive reduction or not, and with good stability in arch length and width. Maxillary midline spacing, however, has been seen to re-emerge. An abnormal maxillary labial frenum and/or an intermaxillary osseous cleft do not appear to favor diastema relapse, but a wider initial space and positive family history predispose the patient to the high instability of diastema closure.[32] With respect to iatrogenic factors, teeth with more root resorption or greater loss of crestal bone height have an increased chance of relapse.[17]

Arch form

In order to reduce the propensity for relapse, teeth should be aligned within the original lower arch form.[33] Transverse expansion, while expansion in the premolar and then molar regions may be less unstable. It has been shown that the magnitude of lateral and anteroposterior arch expansion with non-extraction treatment could differ

between self-ligating and conventional bracket systems and possibly include stability. Little effect, however, was recorded in incisor inclination and less than 1 mm increase in mandibular intermolar distance with self-ligating (SmartClip, 3M Unitek, Monrovia, Calif, USA) when compared to conventional pre-adjusted edgewise (Victory, 3M Unitek, Monrovia, Calif, USA) appliances.[17] Even so, claims that non-extraction treatment may be more stable remain unresolved. In the maxillary arch, comparable expansion and relapse were observed, irrespective of whether a quad helix appliance with conventional brackets or a self-ligating system was used; no difference was recorded in ultimate stability in transverse arch dimensions and incisor positions between treatments.

Miscellaneous factors associated with stability

Other factors include the preservation of the original lower arch form, the preservation of the initial lower labial segment position, and the avoidance of lower intercanine or anteroposterior expansion.[17]

Retention strategy

Since tooth position continues to alter unpredictably and variably post-treatment, and as we cannot identify those that do and those that do not relapse, long-term retention is now prescribed universally.[17] This, however, has a resultant burden on the patient and practitioner. Nonetheless, indefinite follow up as change continues in the future, particularly with the concept of long-term retention, may not be the answer to preventing late lower incisor crowding. With growth, soft tissue changes, compliance with retainer wear, and clinician control, it is unrealistic to believe that the entire dentition can be retained in all dimensions.[17] Indeed, favourable movement (settling) may occur over time in some cases. Post-treatment, the clinicians should maintain proper patient records, including diagnosis, chief complaint, clinical features, and patient preferences. Clinicians must provide instructions regarding retainer wear. Techniques such as end-of-treatment arch wire removal for a definite time before debond allow occlusal settling and 'test the water' regarding the likelihood of relapse.[17]

CONCLUSION

The retention phase is a critical component of orthodontic treatment, and understanding the factors affecting retention is essential for long-term stability. By addressing these factors and implementing appropriate retention protocols, orthodontists can enhance treatment outcomes, minimize relapse, and ensure the longevity of corrected tooth positions, leading to improved oral health and patient satisfaction.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Najjar HE, Alasmari RM, Al Manie AM, Balbaid KM, Alzaher KH, Assiri AT et al. Factors affecting retention and relapse in orthodontics. Int J Community Med Public Health 2023;10:2946-50.