UPDATE

Complications related to fixed retainers in orthodontics: "Twist effect". Bibliographic review.

Complicaciones relacionadas a la contención fija en ortodoncia:"Efecto giro". Revisión Bibliográfica

Complicações relacionadas à contenção fixa em ortodontia: "Efeito rotação". Revisão bibliográfica

Verónica Riquelme M.[1] 0000-0003-0542-8658
Germán Hempel S.[2] 0000-0002-5207-6977
Katherina Schmidt[3] 0000-0003-2242-6048
Carlos Izquierdo[4] 0000-0003-1819-7086
Cristián Navarrete[5] 0000-0001-8372-0764

DOI: 10.22592/ode2023n41e322

Abstract

Fixed retainers in orthodontics have shown to have excellent results for the stability and durability of the treatment. Despite this, it has been observed that there are certain unwanted tooth movements totally different from a recurrence to its initial position prior to orthodontic treatment. The so-called "twist effect" is one of them and is characterized by an inclination in opposite directions of the contralateral canines, where one presents an inclination towards the vestibular and the other towards the lingual or palatine. It occurs mainly in the jaw, despite the fact that the retainer remains perfectly attached to the teeth. The objective of this bibliographic review is to evaluate the different factors reported in the literature that may be related to the appearance of the "turn effect" and how relevant they may be in its development. In conclusion, it is important to consider the multifactorial nature of this type of complications, where the type and quality of the wire used for containment, together with the patient's periodontal characteristics, have shown some involvement in its genesis, therefore, It is essential to make patients aware of the importance of periodic orthodontic check-ups after the removal of fixed appliances to monitor and control the occlusal results achieved and the status of the installed retention devices.

Keywords: orthodontic retainers, orthodontic wires.

1 Universidad San Sebastián, Chile. veroriquelmem@gmail.com
2 Diploma in Early Orthodontic Treatment for Pediatric Patients. Pontificia Universidad Católica de Chile, Chile.
3 Pontificia Universidad Católica de Chile, Chile.
4 Universidad de los Andes, Chile.
5 Universidad de Chile, Chile.

Received on: 21/Jul/2022 - Accepted on: 20/Nov/2022

Resumen

Las contenciones fijas en ortodoncia han demostrado tener excelentes resultados para la estabilidad y durabilidad del tratamiento. A pesar de esto, se ha observado que existen ciertos movimientos dentarios indeseados totalmente diferentes a una recidiva a su posición inicial previa al tratamiento de ortodoncia. El llamado "efecto giro" es uno de ellos, y se caracteriza por ser una inclinación en sentidos opuestos de los caninos contralaterales, en donde uno presenta una inclinación hacia vestibular y el otro hacia lingual o palatino. Se presenta principalmente en la mandíbula, a pesar de que la contención permanece perfectamente adherida a los dientes. El objetivo de esta revisión bibliográfica es evaluar los distintos factores reportados en la literatura que puedan estar relacionados con la aparición del "efecto giro" y qué tan relevantes pueden ser en su desarrollo. Como conclusión es importante considerar el carácter multifactorial de este tipo de complicaciones, en donde el tipo y calidad del alambre que se utilice para la contención, junto con las características periodontales del paciente demostraron tener cierta participación en la génesis de este, por lo tanto, resulta fundamental concientizar a los pacientes de la importancia de los controles ortodóncicos periódicos posteriores al retiro de los aparatos fijos para monitorear y controlar los resultados oclusales logrados y el estado de los dispositivos de contención instalados.

Palabras clave: Retenedores de ortodoncia, Alambres de ortodoncia.

Resumo

As contenções fixas em ortodontia têm demonstrado excelentes resultados para a estabilidade e durabilidade do tratamento. Apesar disso, observou-se que existem certos movimentos dentários indesejados totalmente diferentes de uma recorrência à sua posição inicial anterior ao tratamento ortodôntico. O chamado "efeito de torção" é um deles, e se caracteriza por uma inclinação em sentidos opostos dos caninos contralaterais, onde um apresenta uma inclinação para vestibular e outro para lingual ou palatino. Ocorre principalmente na mandíbula, apesar do retentor permanecer perfeitamente preso aos dentes. O objetivo desta revisão bibliográfica é avaliar os diferentes fatores relatados na literatura que podem estar relacionados ao aparecimento do "efeito turn" e quão relevantes podem ser no seu desenvolvimento. Em conclusão, é importante considerar a natureza multifatorial deste tipo de complicações, onde o tipo e a qualidade do fio utilizado para contenção, juntamente com as características periodontais do paciente, mostraram algum envolvimento na sua génese, pelo que é essencial conscientizar os pacientes sobre a importância de check-ups ortodônticos periódicos após a remoção dos aparelhos fixos para monitorar e controlar os resultados oclusais alcançados e o estado dos dispositivos de contenção instalados.

Palavras-chave: Contenções Ortodônticas, Fios Ortodônticos.

Introduction

Once an orthodontic treatment—during which teeth have been moved with mechanical appliances until alignment, leveling, and ideal occlusion have been achieved—has been completed, the long-term stability and durability of said treatment become the main concern for both the orthodontist and patients.[1-3] Fixed retainers have yielded excellent results at accomplish-

ing this, showing long-term aesthetic and functional effectiveness.[4-5]

It has been found that between 0.1% and 5% of patients wearing fixed retainers experience failures and unexpected adverse effects over time.[1-3,5-9] These do not involve tooth movements in which teeth return to their initial pre-treatment position. These movements occur mostly in the anterior region. They are independent of the kind of fixed retention used (whether only on the canines or the six anterior teeth) or the type, thickness, or material of the wire used to make the retainer.[3,10-11]

These complications range from fracture of the fixed retention element or bond failure to the so-called "twist effect" in the lower canines.[1-3,6,8 9] The twist effect is an opposite inclination of the contralateral canines in which one canine is inclined in the buccal/vestibular direction, and the other canine is inclined in the lingual/palatal direction, while the fixed retainer remains perfectly attached to the teeth.[1,8] It occurs mainly in the lower arch and has a 1.1% prevalence. This effect can occur from 6 months to 12.5 years after the orthodontic treatment with the fixed retainer in place. The average time for this complication to occur is four to six years after placing the bonded retainer.[1]

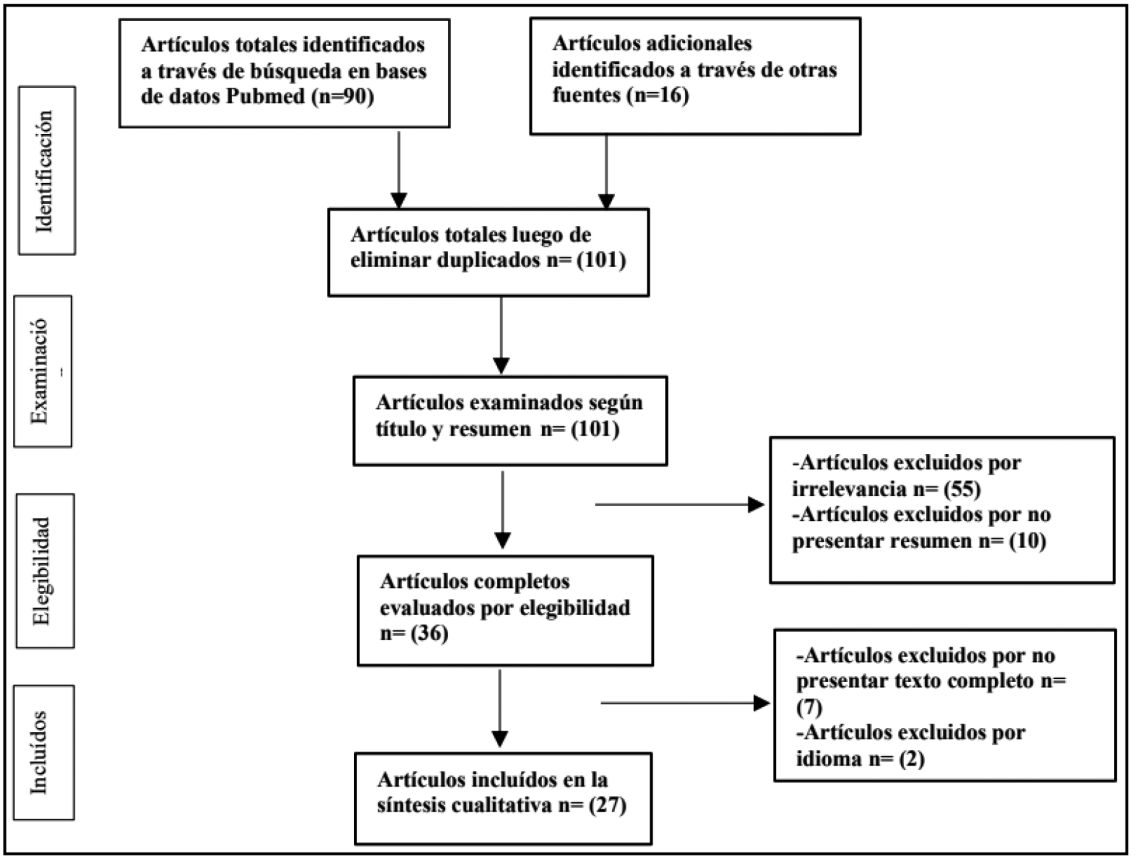
This literature review aims to assess the factors reported in the literature that may be connected to the twist effect and determine how relevant they can be in its development.

Methodology

The literature review was conducted in PubMed, a biomedical literature search engine, combining the following MeSH (Medical Subject Headings) terms: "Orthodontic Retainers/adverse effects" and "Orthodontic Retainers/etiology" together with the Boolean term "OR." We included relevant research papers, reviews, and clinical cases. No papers were excluded based on the year of publication. Articles published in English or Spanish were included. Papers with a subject matter not connected to the topic under study and those for which the full text was not accessible were excluded.

This search strategy yielded a total of 90 studies of potential interest. Eleven studies identified in other sources (Scielo, Google Scholar) were also included. A total of 101 articles were collected in the entire search. Of these papers, 10 were excluded because they did not include an abstract and 55 for not being related to the subject matter. The articles which did not meet the inclusion criteria were excluded: seven because the full text could not be accessed and two due to the language. The total number of studies analyzed in this review was 27, as shown in Fig. 1.

Figure 1. Search methodology and article selection criteria



Theoretical framework

Retainers:

The retention stage is deemed necessary to maintain the correct position of teeth after orthodontic treatment.[12] Retainers can be broadly classified as fixed or removable.[13] There are several designs of fixed retainer, and the most commonly used one is the multistranded wire retainer bonded from canine to canine or a sandblasted round stainless steel wire bonded only to the canines.[13]

Long-term or indefinite retention is recommended. Nevertheless, it is unclear how long retainers must stay in place to reduce the risk of crowding in the anterior region after orthodontic treatment.[17] A retention period of more than eight years with fixed retainers has been found to lead to better maintenance of lower incisor alignment than other studies which reported shorter retention times.[17] An essential factor to consider when planning the retention are the patient's expectations regarding the stability of their lower incisor alignment.[18] Long-term retention should be considered if a patient is unwilling to accept the risk of deterioration in lower incisor alignment following orthodontic treatment.[18]

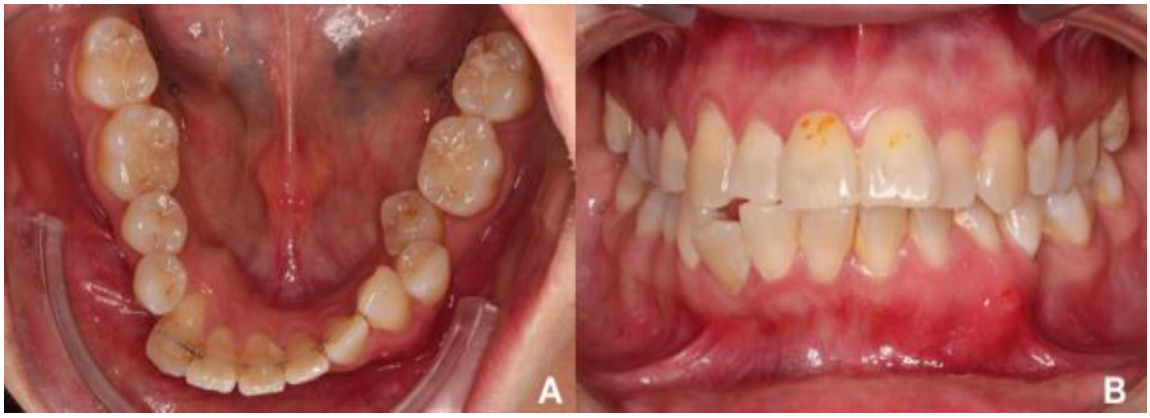
Twist Effect

This phenomenon has been reported in the literature for a few years under the term "severe complications," or "unexpected complications of retention wires." It is most common in the mandible, and timely detection can help avoid severe, sometimes irreversible, periodontal complications.[6,8,9]

In its most frequent form, the canines show an excessive version, in which one canine is inclined in the buccal direction and the other is inclined in the lingual or palatal direction, while the fixed retainer remains perfectly attached to both teeth.[8] Concomitantly, the incisors are projected forward, frontally, leading to tip-to-tip occlusion and, in the case of thin periodontium, to root exposure.[8]

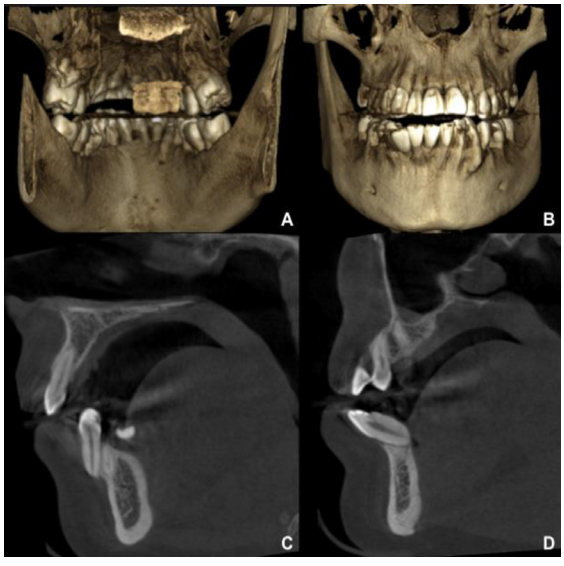
Sometimes, canine version is negligible, and it is the incisor that shows extreme radiculobuccal or coronobuccal version.[8] In some cases, incisors are also misaligned, and their axes are tilted in the same direction as the compromised canine, as shown in figures 2 and 3. In other cases, in which the retainer was placed only on the lower incisors, they are the ones that move as shown in figure 4.

Figure 2:



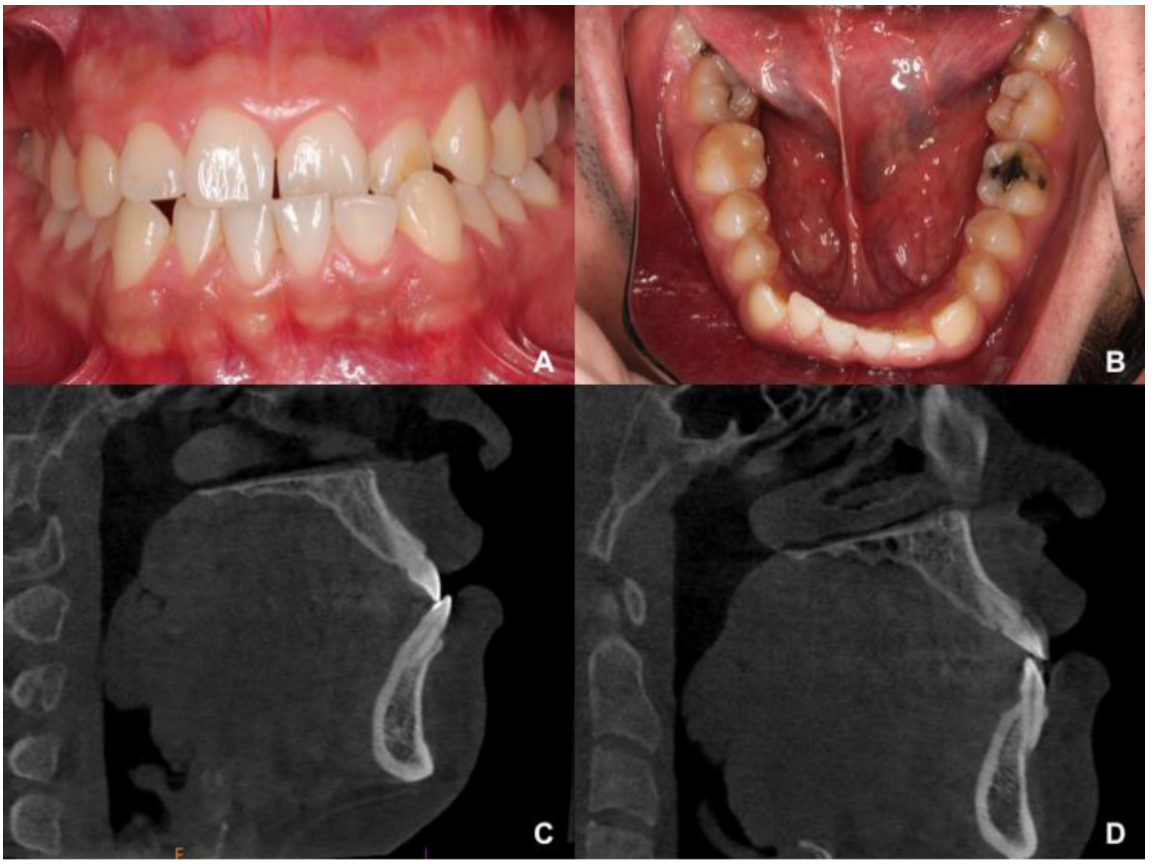
a) Lower occlusal photograph showing the severe inclination of the canines, and in which the fixed retainer was made with a flexible braided arch; b) Front view of the patient in centric occlusion showing occlusal alterations in the anterior region.

Figure 3:



a) Absence of lingual cortical bone related to tooth 4.3; b) Absence of buccal bone plate in relation to tooth 3.3; c) Shows the verticalization of tooth 3.3. d) Shows the buccal inclination of tooth 4.3.

Figure 4:



a) Front view of the patient in centric occlusion; b) Lower occlusal photograph showing the twist effect, which can be caused by a lower fixed retainer made with a flexible braided wire; c and d) Radiographies showing a parasagittal section of teeth 4.2 and 3.2.

Periodontally, torque and translation induce alveolar thinning and root exposure in case of thin periodontium.[8] The twist effect must be detected for the wire to be removed before any periodontal action because surgery would be ineffective if the wire continues to drive the root out of the alveolar bone.[8] Conversely, early periodontal surgery performed as soon as the wire has been removed is pointless since these cases can improve instantly, even without resuming the treatment.[8] The tooth then needs to be repositioned as well as possible orthodontic appliances within the bone to allow intervention on the remaining lesion.[8] If the periodontal lesion is too severe, treatment should be resumed immediately, with periodontal grafting as the final step.[8] If the patient refuses to resume treatment, the retaining wire should be removed to prevent further aggravation.[8]

Discussion

Unexpected complications related to fixed retainers are not, by definition, tooth movements associated with a treatment relapse; they are different and possibly caused by other forces.[6] Although this issue occurs in between 0.1 and 5% of patients, this percentage is acceptable for retainers that will be used for a long time.[9]
Regarding the factors that could be related to this effect, some authors report that patients

tend to push their tongue against the area of the fixed retainer, which could cause deformation, producing forces that cause tooth movement. However, according to other studies, the forces generated by the tongue would be very weak and not continuous enough to generate this effect.[3-8] Other factors that could be considered are some parafunctions, such as nail or object biting, but their involvement in this issue has not been confirmed.[8] Another study concluded that neither the increased intercanine distance nor incisor proclination during treatment were significant predictors of complications.[1] They suggested, however, that there might be an association with incisor proclination in some patients after finishing treatment. Still, it alone probably does not play a role in the development of these issues. They also looked at facial biotypes as a risk factor and found that the difference concerning the mandibular plane angle was relatively small.[1] Another factor analyzed was the average age at which the appliances were removed, considering possible residual growth in growing patients.[1,14] However, the regression analysis did not show that it was a significant predictor.[1] Another significant point to consider is that, during the fabrication and adaptation of the retainer, it has to adapt completely passively to the surfaces of the teeth to be bonded.[1-3,6,8,9].Potential activations during bonding could create forces of up to 1 N, thus causing unexpected complications. Therefore, fabrication, adaptation, and bonding must be conducted very carefully to avoid these complications. An in vitro study showed that the application of vertical forces to the retainers with physiological movements of 0.2 mm created residual forces in the wires of 0.8 N and momentums of 2.2 N/mm after applying the force, especially in flexible retainers with low elastic limits.[21]

The authors emphasize that failures that happen shortly after bonding the retainers could be connected to issues with bonding or with the resins,[1,6] but the complications that appear several years after the retainer was made could more likely be related to the properties of the wire or its variations. They could include the active component of the wire, an elastic deflection caused by the clinician, an unwinding of the multistranded wire, or a mechanical deformation of the wire.[1,2]

Regarding the type of wire, the stability and torsional rigidity of 3-stranded flexible wires have been questioned,[6,20,22] and the use of thicker 5-stranded wires or even rigid rectangular stainless steel wires has been suggested to prevent unexpected posttreatment changes.[1] In this regard, the 5-stranded 0.0215-in wire may appear to be a safer alternative. However, unexpected complications were also identified in patients with this wire, although in fewer patients compared with the 0.175-in 6-stranded coaxial wire, but this difference may be explained by the fact that the 0.175-in coaxial wire is more widely used.[1]

Other studies[6,7] used 3-stranded 0.0195-in heat-treated braided wire (Wildcat; GAC International, Bohemia, NY), whereas others[1] predominantly used a 6-stranded 0.0175-in coaxial wire (Ortho Organizers), and only a small percentage of patients received wires thicker than the 0.0215-in 5-stranded wire (Penta-One). However, no significant differences were found. Therefore, the type of braided wire used does not seem to influence the occurrence of unexpected complications.

Some authors suggest using stiff stainless steel retainers bonded only to the lingual surfaces of the canines, as this would have certain advantages over flexible braided wires given that the patient notices more quickly when they become detached, cause fewer severe complications, and improve hygiene. The issue is that a relatively high percentage of patients experience a slight increase in incisor crowding.[9] Some studies reported no problems with this type of retainer, while other studies report the "twist effect" with this type of retainer as well.[7,8]

Another type of retention proposed involves using dead wires, which, although is the easiest to break or deform, is the least likely to create torque problems. However, the twist effect is also reported with this type of wire.[2,3]

The twist effect appears mainly with braided 3- or 6-stranded wires, but it can also occur with plain wires, chain retainers, retainers that only include the canines, and even with single-stranded 0.032-in steel canine-to-canine wires.[3,8] This higher prevalence might be attributed to multistrand flexible wires being more widely used.[1]

When evaluating the torque resistance results of different wires in an in vitro study, the 0.016-in x 0.016-in steel wire was found to be the most resistant to torque compared to 8-stranded, braided 0.016-in x 0.022-in steel wires, 6-stranded, coaxial 0.0175-in wires, 3-stranded, coaxial 0.017-in wires and 0.039-in x 0.014-in chain wires.[23] Therefore, the authors conclude that to avoid possible complications when the torque is increased, it is important to use a plain wire of larger diameter since they are stiffer, which makes them more resistant to deformation and torsion. Other authors recommend using 0.016 x 0.022-in stainless steel wire, bonded on all 6 anterior teeth, with the 0.022-in side in contact with the tooth surface. However, further studies are needed to determine if this retainer is superior to others.[6]

Multiple authors indicate that applying forces resulting from chewing on hard foods or trauma to plain or braided wires can cause deformation.[2,3,6,9] Specifically, braided wires can have internal tension created both during their fabrication or by applying force during placement, and this tension could increase tooth torque. Therefore, the quality of the wires used should also be considered.

The periodontium is a factor that cannot be overlooked. Both the occurrence and severity of the twist effect depend on the quality and quantity of the surrounding periodontal tissues, especially the buccal cortical plate.[1]

Twist effect complications

Unexpected tooth movements that occur despite the use of lingual fixed retainers can cause various periodontal and dental complications.[1-3,6,8]

At the periodontal level, we can mention buccal bone dehiscence first.[6] It has been shown that increased incisor inclination can cause or worsen bone dehiscences of the vestibular cortical plate, thus reducing bone support around the tooth, mainly in the canines and incisors.[1-3,6,8] Gingival recessions may also occur along with this.[2,3] Orthodontic treatment in combination with a braided wire retainer was shown to promote gingival recession.[2,24,25] The prevalence of gingival recessions increases from 7% at the beginning to 38% after 5 years of using an orthodontic retainer.[7]

At the dental level, it can lead to loss of dental alignment and dental midline misalignment.[1-3,5,8,9] However, one of the most problematic aspects is that 50% of those affected will require orthodontic retreatment, which underlines the importance of early detection.[1]

Recommendations

If these complications occur, there are fundamental aspects concerning clinical management that the treating physician should consider to prevent further progression of the complications.

First, patients should be instructed to see their treating orthodontist if they experience even the slightest movement or fracture of the fixed retainer for immediate removal and repair.[2] A new retainer should be made and passive and securely bonded again.[2,8] Correct adjustment to the lingual surface is essential to adequately position the retainer during bonding and ensure it adapts well to the surface. This can be achieved using a transfer jig to avoid the deformation caused by finger pressure.[2,3] Another option is first to fit the retainer on a working

model.[2,3] Using fixed retainers combined with a removable retainer for nighttime use is also recommended.[2,3]

If tooth movement has occurred, it may be helpful to wait six months to one year before resuming orthodontic treatment to correct the malposition. In some cases, spontaneous recovery reduces retreatment time. In some instances, the return happens without a need for retreatment.[8]

In the case of dehiscences, the recommendation is to complement the treatment with periodontal surgery so that the teeth which are in the correct position also stimulate bone formation in the areas of gingival recession and root exposure.[3,8]

Along with all of the above, periodic check-ups should be emphasized, especially in the first two years after removing the orthodontic appliances and bonding the fixed retainer, when the largest number of failures occur.[3]

Conclusions

It is not possible to attribute the twist effect to one type of wire alone. This problem occurs with multistranded steel wires, flat steel wires, chain retainers, and with retainers bonded only to canines.

Using braided wires can involve the internal tension created during fabrication or placement of the retainer; therefore, it is important to consider passive placement and adaptation of the retainer and work with quality wires.

Using 0.016-in x 0.016-in or 0.016-in x 0.022-in steel wires is recommended, although further studies are needed to determine if this type of retainer is superior to others.

It is important to inform the patient that wearing a retaining wire is not without risk and that check-ups are necessary at least twice a year after the first two years.

It is important to consider the patient's periodontal health and status before, during, and at the end of the treatment.

Managing this type of problem may, in some cases, require interdisciplinary work.

It is worth noting that since this is a multifactorial problem, several factors may cause these complications.

References

1. Kučera J, Marek I. Unexpected complications associated with mandibular fixed retainers: A retrospective study. Am J Orthod Dentofacial Orthop. 2016;149(2):202–11.
2. Pancherz H, Bondemark L. The bite-type malocclusion classification – An extended Angle-method. Is the new classification reliable? APOS trends orthod . 2021;11(100):100–5.
3. Shaughnessy TG, Proffit WR, Samara SA. Inadvertent tooth movement with fixed lingual retainers. Am J Orthod Dentofacial Orthop. 2016;149(2):277–86.
4. Nanda RS, Nanda SK. Considerations of dentofacial growth in long-term retention and stability: is active retention needed? Am J Orthod Dentofacial Orthop . 1992;101(4):297–302.
5. Lai CS, Grossen JM, Renkema A-M, Bronkhorst E, Fudalej PS, Katsaros C. Orthodontic retention procedures in Switzerland. Swiss Dent J. 2014;124(6):655–61
6. Katsaros C, Livas C, Renkema A-M. Unexpected complications of bonded mandibular lingual retainers. Am J Orthod Dentofacial Orthop . 2007;132(6):838–41.
7. Renkema A-M, Renkema A, Bronkhorst E, Katsaros C. Long-term effectiveness of canine-to-canine bonded flexible spiral wire lingual retainers. Am J Orthod Dentofacial Orthop. 2011;139(5):614–21.
8. Roussarie F, Douady G. A side-effect of bonded retention wires: the "wire syndrome": part 1. J dentofac anom orthod. 2016;19(1):106.

9. Pazera P, Fudalej P, Katsaros C. Complication sévère d'une contention collée linguale mandibulaire. Orthod Fr. 2014;85(2):217–22.
10. Kapila S, Sachdeva R. Mechanical properties and clinical applications of orthodontic wires. Am J Orthod Dentofacial Orthop. 1989;96(2):100–9.
11. Sifakakis I, Pandis N, Eliades T, Makou M, Katsaros C, Bourauel C. In-vitro assessment of the forces generated by lingual fixed retainers. Am J Orthod Dentofacial Orthop. 2011;139(1):44–8.
12. Horowitz SL, Hixon EH. Physiologic recovery following orthodontic treatment. Am J Orthod. 1969;55(1):1–4.
13. Johnston CD, Littlewood SJ. Retention in orthodontics. Br Dent J . 2015;218(3):119–22.
14. Little RM, Riedel RA, Artun J. An evaluation of changes in mandibular anterior alignment from 10 to 20 years postretention. Am J Orthod Dentofacial Orthop. 1988;93(5):423–8.
15. Little RM. Stability and relapse of dental arch alignment. Br J Orthod. 1990;17(3):235–41.
16. Richardson ME. Late lower arch crowding facial growth or forward drift? Eur J Orthod. 1979;1(4):219–25.
17. Sadowsky C, Schneider BJ, BeGole EA, Tahir E. Long-term stability after orthodontic treatment: nonextraction with prolonged retention. Am J Orthod Dentofacial Orthop. 1994;106(3):243–9.
18. Kocher KE, Gebistorf MC, Pandis N, Fudalej PS, Katsaros C. Survival of maxillary and mandibular bonded retainers 10 to 15 years after orthodontic treatment: a retrospective observational study. Prog Orthod. 2019;20(1):28.
19. Mills JR. The stability of the lower labial segment. A cephalometric survey. Dent Pract Dent Rec. 1968.
20. Pizarro K, Jones ML. Crown inclination relapse with multiflex retainers. J Clin Orthod. 1992
21. Sifakakis I, Eliades T, Bourauel C. Residual stress analysis of fixed retainer wires after in vitro loading: can mastication-induced stresses produce an unfavorable effect? Biomed Tech (Berl). 2015;60(6):617–22.
22. Dahl EH, Zachrisson BU. Long-term experience with direct-bonded lingual retainers. J Clin Orthod. 1991;25(10):619–30.
23. Arnold DT, Dalstra M, Verna C. Torque resistance of different stainless-steel wires commonly used for fixed retainers in orthodontics. J Orthod. 2016;43(2):121–9.
24. Pandis N, Vlahopoulos K, Madianos P, Eliades T. Long-term periodontal status of patients with mandibular lingual fixed retention. Eur J Orthod. 2007;29(5):471–6.
25. Levin L, Samorodnitzky-Naveh GR, Machtei EE. The association of orthodontic treatment and fixed retainers with gingival health. J Periodontol. 2008;79(11):2087–92.
26. Richardson ME, Gormley JS. Lower arch crowding in the third decade. Eur J Orthod. 1998;20(5):597–607.
27. Al-Moghrabi D, Pandis N, Fleming PS. The effects of fixed and removable orthodontic retainers: a systematic review. Prog Orthod 2016;17(1):24.

Authorship contribution:

1. Conception and design of study
2. Acquisition of data
3. Data analysis
4. Discussion of results
5. Drafting of the manuscript
6. Approval of the final version of the manuscript

VR has contributed in 1, 2, 3, 5 y 6.
GH has contributed in 1, 2, 3, 4, 5 y 6.
KS has contributed in 1, 2, 3, 4 y 5.
CI has contributed in 1, 2, 3, 4 y 5.
CN has contributed in 1, 3 y 6.

Acceptance note:

This article was approved by the journal's editor, MSc Dr. Vanesa Pereira-Prado.