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Using the quad helix to treat bruxism in children: a clinical case

Uso do quadrihélice para o tratamento do bruxismo em criança: um caso clínico

Uso del quad helix para el tratamiento del bruxismo en niños: un caso clínico

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Abstract
Objective: To present a treatment for bruxism in children using quad helix as an intraoral device based on a clinical case. *Methodology*: A case report. *Results:* At the end of the treatment, the presence of the quad helix afforded enough space for the eruption of the permanent teeth, as well as had changed the child's occlusal pattern, deprogrammed the parafunctional habit, cultivated a functional muscle pattern, reduced hyperactivity, and completely relieved all painful symptomatology. *Conclusion:* The use of quad helix for 4 months, along with achieving its orthodontic function, proved capable of increasing the patient's proprioception by enhancing the non-visible recognition of the spatial location of the mandible, deprogramming the child's bruxism, and consequently eliminating all pain in the temporal and superficial masseter masticatory muscles.
Keywords: Bruxism; Facial pain; Orthotic devices; Proprioception.

Resumo
Objetivo: Apresentar uma forma de tratamento para o bruxismo em criança, utilizando como dispositivo intraoral o aparelho quadrihélice, através de um caso clínico. *Metodologia:* Um relato de caso. *Resultados:* Ao final do tratamento, a presença do quadrihélice proporcionou espaço suficiente para a erupção dos dentes permanentes, além de ter alterado o padrão oclusal da criança, desprogramado o hábito parafuncional, cultivado um padrão muscular funcional, reduzido a hiperatividade e aliviou completamente toda a sintomatologia dolorosa. *Conclusão:* O uso do quadrihélice por 4 meses, juntamente com o cumprimento de sua função ortodôntica, mostrou-se capaz de aumentar a propriocepção do paciente ao aprimorar o reconhecimento não visível da localização espacial da mandíbula, desprogramando o bruxismo da criança e, consequentemente, eliminando toda dor em os músculos mastigatórios temporal e masseter superficial.
Palavras-chave: Bruxismo; Dor facial; Aparelho ortopédico; Propriocepção.

Resumen
Objetivo: Presentar un tratamiento para el bruxismo en niños utilizando quadhelix como dispositivo intraoral basado en un caso clínico. *Metodología*: Reporte de un caso. *Resultados:* Al final del tratamiento, la presencia del quadhelix

permitió suficiente espacio para la erupción de los dientes permanentes, así como también cambió el patrón oclusal del niño, desprogramó el hábito parafuncional, cultivó un patrón muscular funcional, redujo la hiperactividad y alivió por completo toda la sintomatología dolorosa. *Conclusión:* El uso de quadhelix durante 4 meses, además de lograr su función ortodóncica, demostró ser capaz de aumentar la propiocepción del paciente al potenciar el reconocimiento no visible de la ubicación espacial de la mandíbula, desprogramar el bruxismo del niño y consecuentemente eliminar todo dolor en los músculos masticatorios masetero superficial y temporal.
Palabras clave: Bruxismo; Dolor facial; Aparatos ortopédicos; Propiocepción.

1. Introduction

Bruxism is a neuromuscular dysfunction considered to be a parafunction of involuntary muscular activity characterized by the act of grinding and clenching the teeth. A parafunction controlled by the central nervous system and influenced by peripheral factors, bruxism can manifest while the individual is awake (i.e., *wakeful bruxism*) or asleep (i.e., *sleep bruxism*) (Firmani et al., 2015; Manfredini & Lobbezoo, 2021; Salas & Gonzalez, 2022). The etiology of the parafunction is multifactorial, for it encompasses psychosocial, postural, neurological, and physiological factors, among others (Firmani et al., 2015; Manfredini & Lobbezoo, 2021). A classic sign of bruxism is dental wear on the incisal edges of anterior teeth and on the occlusal face of posterior teeth, although such does not happen in all cases (Machado et al., 2007). Beyond dental wear, the events caused by involuntary activity encompass headache, facial muscle pain, temporomandibular joint disorders, respiratory problems, behavioral disorders, and apnea, among others (Firmani et al., 2015; Manfredini & Lobbezoo, 2021).

In children exist variations at the prevalence of bruxism, and is frequently reported by parents, at dentist offices, who have observed their sleeping children's intense noise due to teeth grinding (Machado et al., 2014). Factors of bruxism in children include high levels of anxiety, stress, other oromandibular parafunctions, and malocclusions (Firmani et al., 2015). Beyond that, the bruxism may also relate to signs and symptoms of temporomandibular dysfunction (TMD), because the TMD are multifactorial (Manfredini & Lobbezoo, 2021). Studies have shown that though the conditions of TMD are similar between adults and children, they present in different ways depending on the stage of craniofacial growth and development and the great adaptation of children to changes in the structures of their stomatognathic systems. Bruxism has also been shown to be more prevalent in children with other symptoms that may indicate TMD and is therefore a strong predisposing factor for the development of TMD in children (Loddi et al., 2010).

Currently its frequently observed that children who develop signs and symptoms of TMD due to bruxism, including muscular pain and limited mandibular opening, the therapeutic management of bruxism aims to improve those symptoms (Loddi et al., 2010; Firmani et al., 2015). Because bruxism is considered to be multifactorial, dental, pharmacological, and psycho-behavioral strategies are recommended for its treatment (Shetty, Pitti, Babu, Kumar & Deepthi, 2010). Dental therapy includes the use of rigid interocclusal devices to protect the permanent dentition and the masticatory system due to the ease of use, low cost, and reversibility, moreover, to reduce muscle hyperactivity, the therapy reversibly increases the vertical–occlusal dimension, reduces intra-articular pressure, and protects teeth from wear due to friction (Firmani et al., 2015). Pharmacological therapy in adults involves the use of medications, including muscle relaxants, which should be administered for only a short period of time and with caution and are recommended only in severe cases with the aims of lowering stress and anxiety and increasing the quality and quantity of sleep (Shetty et al., 2010). Psychological therapies are important to achieve changes in habits and reduce stress as means to achieve a healthier lifestyle, as well as contribute to the identification of the causal factor of bruxism (Firmani et al., 2015).

Regarding the treatment of bruxism in deciduous and mixed dentition, there is insufficient evidence to justify the use of interocclusal devices, for their use would compromise the alveolar growth of the maxillary bone and impair the eruption of permanent teeth (Firmani et al., 2015). In that context, this article presents a treatment for bruxism in children, one based on

orthodontics and orthopedics in maxillaries, using a quad helix to expand the midpalatal suture, deprogram the neuromuscular reflex of clenching or grinding the teeth associated with the detection and control of the habit of bruxism, and, in turn, increase the patient's proprioception. This unprecedented study had the purpose of examining the clinical treatment of bruxism in a child with an indication for the use of a quad helix to increase space in the upper arch, a treatment that may also serve as an alternative means of detecting and controlling the habit of bruxism.

2. Methodology

This study is a narrative review based on a case report. This is an unprecedented research not yet reported in the literature, which was supported by a bibliographic search in the PubMed and Scielo databases about the functionality of the quad-helix apparatus, alteration of proprioception through the use of intraoral devices and in relation to the adaptation of children in front of changes in the structures of the stomatognathic system, according to Firmani et al. (2015). The case was treated after signing the Informed Consent Form by the patient's legal guardian. Follow-up was carried out through several consultations from February 2021 to the present day, with the use of the quad-helix for 4 months in the initial period of treatment, in which the clinical procedures were planned according to the evolution of the case and age of the patient child.

3. Clinical Case Report

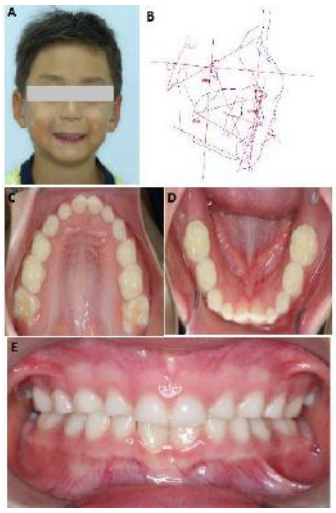
Patient EGO, a male 6 years and 4 months old, attended the dental clinic with the complaint of a lack of space to erupt the permanent teeth, facial pain, and wear on the deciduous teeth, as reported by the patient's mother. The analysis and treatment of the patient were initiated after she signed an informed consent form. The mother reported that the patient was breastfed until he was 2 years and 10 months old, had never used a bottle or spout, was not a mouth breather, and did not have any deleterious habits. Breastfeeding was exclusive until the age of 6 months, after which solid and liquid foods were introduced along with breastfeeding, the latter of which continued until the child was 2 years and 10 months old, as mentioned. The patient's diet has always been healthy and without the excessive consumption of foods rich in carbohydrates and sugars as a means to prioritize fruits and vegetables. At birth, the patient weighed 3 kg and 150 g and was 50 cm long, and his nationality is north American. The child is considered of yellow race, being his mother of white race, his father and both paternal grandparents of yellow race, all three were born in Brazil, and only the paternal great-grandparents were born in Japan.

The patient's orthodontic documentation included an extraoral examination from the frontal view (Figure1A), which, together with complementary exams and a Ricketts (Figure1B) tracing analysis, indicated a slightly convex profile, a skeletal deep bite, mild protrusion of the maxilla, mandibular orthognathism, and a short mandibular length but with a favorable tendency for growth due to being brachyfacial. As a result of complementary exams and Ricketts tracing, the proportion and measurements of the facial thirds, the angle formed between the body and the mandibular ramus, and the position of the molars and incisors in relation to their supporting bones were observed, all of which indicated the patient's normal pattern (Figure1B). Aged 6 years and 4 months, the patient was in the growth phase, that it is essential to assess the rate of skeletal maturation and determine the child's growth potential.

Upon intraoral examination, the patient showed mixed dentition in teeth 51, 52, 53, 54, 55, 16, 61, 62, 63, 64, 65, 26, 31, 72, 73, 74, 75, 41, and 82, 83, 84, 85 (Figure 1C). The patient also exhibited mild maxillary atresia and severe bruxism, characterized by incisal wear on teeth 51, 52, 53 and 61, 62, 63 and occlusal wear on teeth 54, 55, 64, and 65 (Figure 1C), in addition, a slight linguoversion of the lower permanent central incisors was noted (Figure1D). Intraoral examination revealed that the patient had all of the elements of deciduous dentition (Figure1E). A year and 2 months after orthodontic documentation was made, the patient returned to the dental clinic at the age of 7 years and 6 months to begin orthodontic

treatment, as recommended by the orthodontist. Although the patient's mother had reported usually hearing noises due to her son's grinding his teeth while asleep, with the outbreak of the COVID-19 pandemic in early 2020 she began hearing the noises more frequently while he was awake as well, in addition to the already reported nocturnal bruxism.

Figure 1 - Part of the patient's first orthodontic documentation.



1A: Frontal-view extraoral photograph used to evaluate the patient's facial pattern
1B: Ricketts cephalometry to evaluate the proportions and measurements of the patient's facial thirds
1C: Upper occlusal intraoral photograph of the patient's mixed dentition showing slight maxillary atresia, incisal wear on teeth 51, 52, 53 and 61,62, 63, and occlusal wear on teeth 54, 55, 64, and 65.
1D: Lower occlusal–intraoral photograph of patient's mixed dentition showing the linguoversion of the lower central incisors.
1E: Intraoral photograph of the anterior region showing all of the deciduous teeth positioned along the dental arch.
Source: Authors.

Having already provided orthodontic documentation, the patient underwent new panoramic radiography to check the eruption and positions of his permanent teeth. The radiograph showed the exfoliation of teeth 51, 61, 62, 72, and 82 and the eruption of permanent teeth 11, 21, 32, 42, 36, and 46 (Figure 2A). Moreover, radiographic examination revealed a lack of space in the arch for the eruption of the upper lateral permanent incisors 12 (Figure 2B) and 22 (Figure 2C), as confirmed by intraoral examination, which also indicated the persistence of the patient's bruxism through accentuated dental wear on teeth 52, 53, 54, 55 and 63, 64, 65 (Figure 2D). The patient presented occlusion suggestive of Class I right and left permanent molars in bracketing, Class II right and left canines, and right and left deciduous molars presenting a mesial step (Figure 2B and Figure2C).

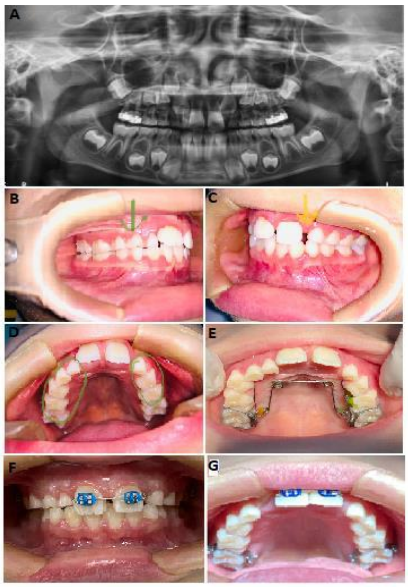
During clinical care, to assess the patient's complaint of facial pain, the pain was measured using the visual analog scale (EVA), which characterizes the intensity of pain from 0 to 10, with 0 points indicating no pain, 1–3 points indicating mild pain, 4–6 points indicating moderate pain, and 7–10 points indicating severe pain (Menetii et al., 2011). Per the results of the scale, 7 points were given to the right anterior temporalis muscle, 7 points to the left anterior temporalis muscle, 6 points to the left superficial masseter muscle, and 9 points to the right superficial masseter muscle, in which case the child cried out in pain when the musculature was palpated. The diagnosis of bruxism associated with local myalgia of the temporalis and superficial masseter masticatory muscles was therefore established, as was the lack of space for the eruption of the upper lateral incisors. In response, the correction of mild maxillary atresia was proposed using a quadhelix (Figure 2E) in order to expand the maxillary in order to ensure that the patient's palatal plane would be lower, which would therefore ensure a larger nasal store, improve the possibility of nasal breathing, increase space for the eruption of the upper lateral incisors, ensure that the canines would not interfere in the rhizogenesis of teeth 12 and 22, improve the buccal corridor, and deprogram bruxism. To

that end, orthodontic treatment began with the installation of a quadhelix onto the upper permanent molars 16 and 26 (Figure 2E).

Four months after the beginning of orthodontic treatment, with the quad helix installed in the mouth, the child returned to the dental office and exhibited the expansion of the midpalatal suture and the correction of maxillary atresia, as was necessary, which enlarged space in the arch for the eruption of teeth 12 and 22 (Figure 2E). Moreover, a new form of occlusal contacts was established, one favoring changes in proprioception and the control of bruxism. Beyond that, the child's mother reported that his grinding noises had decreased and that his painful symptoms had ceased, as confirmed by a visual analog score of 0 during palpation of the masticatory muscles. At this appointment, the orthodontist opted to remove the quad helix, once was given the final appearance of maxillary expansion and deprogramming with complete control of the teeth-clenching habit. Thus, a segmented appliance was installed on teeth 11 and 21 following sectional mechanics due to an interincisal diastema between the upper permanent central incisors (Figure 2F). The appliance was installed to create space for the complete eruption of teeth 12 and 22, for the upper permanent central incisors occupied part of the space of the upper permanent lateral incisors and had thereby created a large interincisal diastema. For that reason, the segmented appliance was installed on those teeth, while the orthodontic band was kept on the upper first permanent molar (Figure 2F).

In a new appointment 5 months after the installation of the appliance with sectional mechanics, the segmented archwire and elastic allowed the leveling of teeth 11 and 21 along with their approximation, which closed the interincisal diastema and provided the necessary space for the eruption of teeth 12 and 22 (Figure2G). The approximation and leveling of the upper central incisors provided space for the eruption of the lateral incisors. During the same visit, it was possible to observe tooth 12 in the process of eruption (Figure 2G). The patient continues to be followed up and maintains deprogramming with complete control of the habit of bruxism. Following the complete eruption of the upper permanent lateral incisors, a bracket will be installed on those teeth to enable mechanics to begin with the base arch, which will span from the upper first permanent molars to the upper permanent incisors, thereby making it possible to control the space necessary for the eruption of the permanent canines and premolars.

Figure 2 - Radiographic and clinical aspects of the patient's mouth immediately before the start of orthodontics and jaw orthopedics during and after the use of the quad helix.



2A: Panoramic radiograph showing teeth 11, 21, 32, 42, 36, and 46
2B: Right intraoral photograph showing the lack of space for the eruption of tooth 12
2C: Left intraoral photograph showing the absence of space for the eruption of tooth 22

2D: Upper occlusal photograph showing the patient's mixed dentition, with incisal wear on teeth 52, 53, and 63; occlusal wear on teeth 54, 55, 64, and 65; and slight maxillary atresia
2E: Quad helix appliance installed in the mouth to allow the expansion of the midpalatal suture and correction of maxillary atresia
2F: Intraoral photograph showing a segmented appliance installed on teeth 11 and 21 and the presence of an interincisal diastema
2G: Intraoral photograph of the upper arch showing teeth 11 and 21 leveled and close together, space gained for the upper lateral incisors, and the eruption of tooth 12.
Source: Authors.

4. Discussion

The quad helix appliance was introduced by Ricketts in 1975, following the bioprogressive philosophy, this appliance acts by compressing the periodontal ligaments, displaces the alveolar processes, tilting the anchorage teeth, and gradually opening the mesiopalatal suture, thereby allowing a slow expansion of the maxilla and the bone remodeling (David,1975), which was necessary in the patient's case to make room in the maxilla and allow the correct eruption of tooth 12. The quad helix was chosen in the case given the need for maxillary expansion, because it is well tolerated in children aged 3 years or more, and because it performs a slow orthodontic movement that does not adversely interfere in the eruption of the child's permanent teeth. The child in the case showed mixed dentition at the beginning of the orthodontic treatment, which aligns with the Duarte (2006) statement that orthodontic intervention, following bioprogressive science, can be adopted in mixed and permanent dentition because it is simple and applies light forces between 2N and 6N (Newton force measure).

Since 1980, functional orthopedic treatment has been recommended in children owing to its ease and speed and because results with mixed dentition are better from the standpoint of growth, repair, and tissue response. Added to that is the fact that earlier treatment has a greater likelihood of achieving stability (Siriwat & Jarabak, 1985). Thus, because much of the literature states that 80% of growth occurs between 6 and 7 years of age, if orthodontic treatment is not performed at that age, then it can cause skeletal changes in the child's facial pattern and have consequences beyond the lack of space in the dental arch, lack of space for the eruption of permanent teeth, crowding in the anterior region of the arch, teeth in supraversion and development of malocclusions. Therefore, we prioritized an intervention in the patient's case based on orthodontics and jaw orthopedics using the quadhelix to expand the midpalatal suture because, according to Souza et al. (2021), orthodontic treatment during a child's growth period is fundamental due to the success of bone remodeling during that phase, which ensures a favorable treatment prognosis and the patient's proportional facial development.

We used the quad helix appliance in the patient's case in order to change his proprioception, with the chief aim of deprogramming the habit of bruxism and creating a new form of occlusal contact, which agrees with Loddi et al. (2010), who have observed children's exceptional adaptability in facing changes in the structure of the stomatognathic system. Bruxism is associated with sleep-related difficulties and low socioeconomic status, as found in a study conducted with 556 children in Brazil (Amaral et al., 2022). However, those factors did not apply to the child in our clinical case, who did not present sleep-related difficulties but, on the contrary, had observed regular bedtimes, slept through the night, and woke up at the same time since he was 2 years old.

Even so, the COVID-19 pandemic, caused by infection with SARS-CoV-2 and announced in March 2020, has raised the risk of major health-threatening conditions, including oral habits that are deleterious to physical and mental health and directly influence individuals oral and maxillofacial conditions, including TMD and bruxism. Those concerns align with the findings of Firmani et al. (2015), who have reported that psychosocial factors, including high levels of anxiety, stress level, and TMD, are risk factors for the development of bruxism in children. In our case, the child's bruxism had intensified since the beginning of the pandemic, as reported by his mother, who had observed him clenching his teeth during the day and reported the consequent pain in his masticatory muscles. Those conditions were aggravated due to stress experienced during the pandemic and abrupt changes in the child's routine, including the interruption of school activities, according to Permanln et al. (2020) and Rocha et al. (2021), orofacial pain and TMD have become more pronounced during the COVID-19 pandemic,

which has increased the prevalence of and worsened TMD and bruxism symptoms in the population. In that context, the treatment of bruxism in children has become a health necessity, for the presence of symptoms typically accompanies shifts in the individual's quality of life and interference in their psychosocial relationships.

In our case, the therapy chosen to treat bruxism involved orthodontic intervention using a quad helix, which has been associated with the detection and control of the habit of bruxism, accompanied by orienting the child to changes in their habits. The choice of the quad helix, a functional orthopedic appliance, to treat bruxism in the case was partly based on the patient's dental arch condition, which showed a remarkable lack of space for the eruption of permanent teeth. In response, the quad helix worked as a maxillary expander, according to Duarte (2006), one capable of allowing the reconstruction of an adequate arch by means of dentoalveolar expansion and, in turn, the possibility of unlocking malocclusions and establishing normal function. Moreover, using the quad helix allowed changing the child's proprioception in order to deprogram the habit of bruxism and adopt a new form of occlusal contact, which corroborates with Loddi et al. (2010) who founds that children can readily adapt to changes in the structure of their stomatognathic system. Responsible for mastication, speech, and swallowing, the stomatognathic system is composed of the periodontium, muscles, ligaments, the temporomandibular joint, and neurological and vascular systems, all of which share a physiological interconnection, so that according to Okeson (2008), the disorder or malfunction of any of them can destabilize the entire system, including parafunctional habits such as bruxism. In most cases, bruxism is treated by using rigid interocclusal stabilizing plates in adults, which can reduce myofascial pain due to parafunction and protect natural dentition (Steurer et al., 2018).

However, in children, the use of interocclusal stabilizing plates is not indicated for either deciduous or mixed dentition, because their use would compromise the alveolar growth of the maxillary bone, thereby impairing the correct and physiological eruption of permanent teeth (Firmani et al., 2015). For that reason, in this case was opted to use a quad helix. In addition to the orthodontic correction, it was necessary to deprogram the neuromuscular reflex of clenching and grinding in the child, in which case using the quadhelix served to increase the patient's proprioception by increasing the non-visible recognition of the spatial location of the mandible. The mechanism was similar to that of using rigid interocclusal stabilizing plates in adults, that concords with Okeson (2008) who says that the primary function of the interocclusal device is to reorganize the neuromuscular activity of the individual.

Therefore, using a quad helix can not only achieve maxillary expansion but also likely change the proprioceptive mechanism in children, how affirms Steurer et al. (2018) which showcases its ability to alter children's occlusal pattern, deprogramming the parafunctional habit of grinding and clenching teeth, and, consequently, obtaining a functional muscle pattern, reducing muscle hyperactivity, relieving or eliminating painful symptomatology, and improve quality of life. Following the treatment in our patient's case, we observed an improvement in bruxism and the complete resolution of the child's painful symptomatology in the temporal and superficial masseter masticatory muscles, along with the correction of maxillary atresia, which provided space in the arch for the eruption of the upper lateral permanent incisors, That space has been maintained with the segmented appliance following sectional mechanics, the goal of which is to control the space for the future eruption of permanent canines and premolars while maintaining the occlusal pattern. After all, the segmented arch technique allows various types of tooth movements to be controlled and planned by applying different amounts of movement and forceon brackets (Almeida et al., 2006).

5. Final Considerations

The treatment of bruxism in children involves several factors since this parafunction has a multifactorial etiology. In the presented case, the treatment included the functional orthopedics of the jaws, through the use of the quad helix for 4 months, associated with the orientations of postural changes through the detection and control and the habit of bruxism. In this

way, the use of the quad helix appliance allowed, in addition to the orthodontic correction, necessary in this case, to deprogram the parafunctional habit of bruxism, by altering the child's proprioception with the device installed in the mouth, obtaining a functional muscle pattern, reducing hyperactivity and completely relieving the painful symptomatology felt by the child.

Despite the literature presenting numerous forms of treatment for bruxism, the use of rigid interocclusal splints being the most widely used, the present work presents an alternative for the treatment of bruxism in children, with the use of a functional orthopedic device, which, in addition to the orthodontic function, is able to deprogram and control the parafunctional habit of bruxism, since in deciduous and mixed dentition the use of occlusal splints is not recommended, due to possible alterations that may influence the correct eruption of permanent teeth. Therefore, the use of the quad helix apparatus, in this case, proved to be capable of deprogramming bruxism in children, allowing control of the parafunction and, consequently, alleviating the facial muscle pain that the patient had.

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