

PREPROSTHETIC ORTHODONTIC TREATMENT

TRATAMENTO ORTODÔNTICO PRÉ-PROTÉTICO

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A Odontologia moderna busca atualmente tratamentos que restaurem função e estética dos elementos dentários, levando também em consideração os fatores biológicos envolvidos na saúde bucal. O tratamento reabilitador protético pode ser desafiador, principalmente em pacientes adultos, com perdas dentárias e problemas periodontais. Nesse sentido, a busca por uma somatória de bons resultados leva a equipe a unir especialidades como Periodontia, Dentística, Prótese, Implantodontia, Cirurgia Bucomaxilofacial e Ortodontia. Esta última vem sendo uma grande aliada para a reabilitação protética em etapas de diagnóstico e plano de tratamento, proporcionando melhores prognósticos estéticos e funcionais. O presente estudo trata-se de uma revisão da literatura realizada por meio de busca nas bases de dados PubMed e Google Scholar e tem como objetivo abordar os aspectos mais recentes do tratamento ortodôntico pré-protético, enfatizando as principais vantagens, indicações e as formas de estabelecer um plano de tratamento, bem como movimentações ortodônticas em pacientes com agenesia dentária anterior e a utilização de mini-implantes como auxiliares no plano terapêutico. O tratamento ortodôntico pré-protético é um tema considerado atual, e a individualidade de cada paciente faz com que a literatura concentre mais artigos de relato de caso, sendo, por isso, necessários mais estudos que englobem protocolos e indicações para os possíveis casos que venham a surgir na prática clínica. Conclui-se que a Ortodontia sendo inserida nas etapas de diagnóstico e plano de tratamento da reabilitação protética traz benefícios de grande valia na busca de um ambiente reabilitador mais fácil e com maiores garantias de sucesso estético e funcional.

Palavras-chave: Ortodontia; Ortodontia corretiva; fechamento de espaço ortodôntico; prótese dentária; planejamento de prótese dentária.

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Abstract

Modern dentistry is currently seeking treatments that restore the function and aesthetics of dental elements, also considering the biological factors involved in oral health. Prosthetic rehabilitation treatment can be challenging, especially in adult patients with tooth loss and periodontal problems. In this sense, the search for a sum of satisfactory results leads the team to integrate specialties such as Periodontics, Dentistry, Prosthodontics, Implantology, Maxillofacial Surgery and Orthodontics. The latter has been a great ally for prosthetic rehabilitation in stages of diagnosis and treatment plan, providing better aesthetic and functional prognoses. The present study is a literature review performed by searching the PubMed and Google Scholar databases and aims to address the most recent aspects of preprosthetic orthodontic treatment, emphasizing the main advantages, indications, and ways of establishing a treatment plan, as well as orthodontic movements in patients with anterior tooth agenesis and the use of mini-implants as an aid in the therapeutic plan. Preprosthetic orthodontic treatment is considered a current topic, and the individuality of each patient means that the literature concentrates more in case report articles, thus further studies are needed that encompass protocols and indications for possible cases that may arise in clinical practice. We conclude that including orthodontics in the stages of diagnosis and treatment plan of prosthetic rehabilitation brings benefits of great value in the search for an easier rehabilitation environment with greater guarantees of aesthetic and functional success.

Keywords: Orthodontics; corrective Orthodontics; orthodontic space closure; dental prosthesis; dental prosthesis planning.

INTRODUCTION

Modern dentistry values treatments that restore function and aesthetics of a patient's dental elements, also considering the biological factors involved in oral health (1). Treatments currently seek interaction between professionals in a multidisciplinary way, with the application of several techniques based on scientific knowledge, thus allowing surprising rehabilitative treatments (1-2). In this sense, case discussion meetings are beneficial in the sense of learning new techniques and even exchanging opinions that will favor the patient's treatment (3). Some authors also highlight the importance of orthodontics in cases of agenesis of anterior teeth, which present significant aesthetic impairment and often make the rehabilitation treatment complex (4,5).

The search for a sum of satisfactory results leads the team to unite specialties such as periodontics, dentistry, prosthodontics, implantology, maxillofacial surgery and orthodontics (1-6). Therefore, the prosthetic rehabilitation treatment can be challenging in several aspects, especially in adult patients, with tooth loss and periodontal problems. For this reason, orthodontics plays a fundamental role in the treatment and achievement of the final aesthetic objective (3,6,7).

Therefore, the present work aims to approach a literature review, showing the most recent aspects of preprosthetic orthodontic treatment, with a multidisciplinary view, emphasizing the main advantages, indications, and ways to establish an adequate treatment plan for the patient with a joint and integral form, starting with the correct diagnosis. In addition, the study addresses the role of orthodontics in cases of tooth agenesis and the application of mini-implants as an aid in the treatment plan.

LITERATURE REVIEW

A search for publications was performed in the PubMed and Google Scholar databases, using the following keywords: preprosthetic; orthodontics; treatment. English-language articles on the subject, published between 1994 and 2019 (period of 15 years), were reviewed. An initial selection of articles was conducted

through the relevant titles, followed by the reading of the abstracts. Articles that adequately addressed the research topic were selected for full reading. Those articles containing cases that did not address prosthetic rehabilitation or orthodontic treatment were discarded, totaling 20 articles selected to compose the literature review.

The literature shows that orthodontics plays a fundamental role in prosthetic rehabilitation and how it is possible to combine different techniques to create space, align dental elements or even contribute to the root/crown relationship (2,7). However, it is important to consider some aspects before orthodontic and rehabilitation planning, such as periodontal condition, patient age, expectations involved, time and cost of treatment (3,6). Therefore, the correct establishment of the diagnosis followed by a correct definition of the treatment plan can be crucial for achieving treatment success.

Diagnosis and Treatment Plan

Establishing an accurate diagnosis is a fundamental factor in establishing the treatment plan, to achieve success, combining factors such as biological, functional, and aesthetic rehabilitation.

Catino et al. establish that orthodontic treatment planning is based on accurate data collection and clinical examination, accompanied by complementary tests such as radiographs and cephalometric tracings. They also suggest that the parameters to be evaluated should include the functionality of the entire stomatognathic system, teeth condition (especially the periodontal health condition), type of bite and breathing (8).

Some authors such as Spear et al. propose an interdisciplinary concept that values aesthetics in the first place. They claim that without considering the aesthetic aspects, the impact on the result can be catastrophic. Therefore, this group of experts suggests a treatment sequence that starts with aesthetic concern, that is, it considers the extent of exposure of the crown of the anterior teeth, either with the lip at rest or while smiling, the midline positioning (displacement to the right or left), a correct inclination of the incisors

and gingival positioning in order to bring a satisfactory aesthetic result, before the concern with biological and functional aspects (1).

Likewise, still in 1997, Almeida et al. already pointed out that among the benefits of using preprosthetic orthodontic treatment are the repositioning of abutment teeth, the opening or closing of spaces and the verticalization of inclined teeth, which facilitate prosthetic rehabilitation, preventing the compromise of vital and healthy teeth, preserving them from unnecessary dental preparations and endodontic treatments to ensure the stability of fixed bridges (9).

Normando et al. published a case specifically dealing with orthodontic extrusion in invasion treatment of periodontal biological spaces. The authors also define clinical crown augmentation surgery as objective and rapid, however, an elongation of the crown can generate an aesthetic compromise regarding the new gingival insertion. Therefore, when cases involve an anterior region with high aesthetic demand, orthodontic extrusion may be the most advantageous option. However, the external shape of the root of the tooth to be extruded must be considered, since a thin and conical root will provide a narrower cervical region after dental extrusion, generating concern from an aesthetic point of view, especially regarding filling of the interdental space through the papilla (10).

The need for rehabilitative treatment may involve cases of dental malformations (conoid teeth, for example), missing teeth, diastema, inadequate proximal contact, and misalignment of the tooth's long axis. In some cases, the dentist chooses tooth extractions followed by rehabilitation with osseointegrated implants, however, this choice may be wrong, as making use of an orthodontic treatment can be simpler and faster (11).

Therefore, orthodontic treatment comprises a series of approaches that can be applied with different objectives in patients of a wide age range. As previously mentioned, this treatment can be beneficial in cases of missing teeth for several reasons, such as occlusal gaps, filling spaces, among others. The planning of the orthodontics stage will be directly influenced by the prosthetic treatment that would be conducted later. Briefly, Catino et al. emphasize

that preprosthetic orthodontic treatment should be as quick as possible, avoiding involving many steps, and should focus on one of the objectives summarized in Table 1 (8).

Anterior tooth agenesis and rehabilitation

Tooth agenesis is considered one of the most common developmental disorders found in the oral cavity. Among dental ageneses, the most common is the third molar, followed by the lateral incisors (12). Some authors also report premolar agenesis as considerably incident (5,13).

The lack of development of the permanent tooth element is related in the literature with genetic factors that are currently well-described (5,14). Although it does not always bring real consequences to the individual - especially when it involves the third molar -, the tooth agenesis of the lateral incisor generates a greater impact due to the aesthetic involvement, as it is an anterior tooth and important for the alignment of the smile. This agenesis can be uni- or bilateral, however, when it is only presented unilaterally, it is common for the contralateral tooth to present microdontia and be conoid since the genetic basis involved is the same (15).

In terms of treatment for anterior tooth agenesis, two options can be considered: closing the space with alignment and contouring of the canine tooth; or prosthetic rehabilitation. Kiliaridis et al. considered 12 articles in their systematic review, and in this data survey, the authors show that 61.47% of the cases were treated with space closure by pulling the canine orthodontically and subsequently contouring this dental element for better aesthetic and functional presentation (16). Interestingly, the authors also point out that even in cases where the option was prosthetic rehabilitation, 95.5% of them had a previous stage of orthodontic treatment, either to open or maintain the space between the central incisor and the canine. Preprosthetic orthodontic treatments are highly recommended in these cases due to the clear tendency of the canine to mesialize in the absence of proximal contact, thus seeking some form of contact with the central incisor (16).

Still considering the systematic review, the aim

Table 1 - General objectives and indications of the main preprosthetic orthodontic movements*

MOVEMENT	PURPOSE/INDICATIONS
<p>Slow extrusion</p>	<p>Indicated for the treatment of defects on one or two dental surfaces, reduction of deep periodontal pocket, correction of the gingival profile;</p>
<p>Fast extrusion</p>	<p>Useful in subgingival caries lesion exposure for proper treatment, treatment of root fracture reduced clinical crown correction, treatment of root perforation. These cases must be monitored every two weeks to avoid gingival fibrosis;</p>
<p>Intrusion</p>	<p>Used for compensation of horizontal bone loss, periodontal pocket reduction, improvement in periodontal ligament insertion, increase in clinical crown extension, incisal margin leveling, correction of tooth extrusion due to lack of antagonist limited to 1-2 mm;</p>
<p>Molar uprighting</p>	<p>Focused on eliminating functional interference, occlusal trauma correction, correcting tooth support that is not parallel, create space for implant placement;</p>
<p>Mesiodistal movement</p>	<p>Distribute the masticatory loads between the abutment teeth according to the planning of the posterior prosthetic treatment.</p>

*Text adapted from Catino et al. (8)

of the authors was to compare the treatments of maxillary lateral incisor agenesis with space closure with orthodontic canine traction or by prosthetic rehabilitation. They indicate that the first alternative achieves better functional, biological, and aesthetic results and should be the option of choice whenever possible (16).

On the other hand, some considerations must be made when choosing this type of treatment. Among them, there is the possibility of the canine presenting an exaggerated volume and thus requiring excessive tooth wear (5,17). Another consideration is regarding the difference in color of the canine tooth, which tends to be more yellowish and the more it is necessary to wear the tooth, the more evident the yellowish color can be (5). One of the suggestions given by Kiliaridis et al. to overcome this problem is changing the canine torque in such a way as to reduce the extension of its labial convexity, disguising the tooth angulation, and requiring less wear for the contour (16). Other alternatives involve whitening the tooth in question or using aesthetic restoration methods such as laminated veneers. In addition, the authors emphasize the importance of checking the height of the interdental papilla and of keeping the contention fixed with resin in the palate of the anterior teeth for prolonged periods (16).

Considering the possibilities of prosthetic treatment after choosing the appropriate orthodontic intervention, three options can be considered:

- I. Rehabilitation with single implant and full crown;
- II. Adhesive fixed bridge;
- III. Fixed partial denture.

Each of the options has advantages and disadvantages, in addition to considerations that should be given special attention when choosing the best treatment for the patient, such as age, aesthetic expectations and cost-effectiveness, also according to the patient's financial conditions (16,17).

Single implants are a good rehabilitation option in cases where there is no dental element. However, care must be taken in pre-prosthetic orthodontic treatment, always trying to make sure radiographically, before

ending the treatment, that the roots of the canine and central incisor are well positioned to allow placement of the implant, especially in cases of space opening in which the canine presents the crown movement faster than the proper alignment of the root portion (5). Olsen and Kokich demonstrated that 11% of the patients in their studies had inadequate root spacing, making it impossible to place the single implant (18). Another important factor to be considered in this treatment modality is the patient's age and, consequently, their complete bone development. In cases where this factor is neglected, implants may present infraocclusion (19). In general, the choice for rehabilitation with implants adequately meets the aesthetic and functional requirements, although it is a more costly option (16).

The fixed adhesive bridge is defined as a prosthesis in which the absence of teeth is replaced by artificial teeth fixed to neighboring teeth, with the use of a metallic structure or not (20). The use of this type of prosthesis was designed to solve previous aesthetic problems and is considered the most conservative option, as it requires only minimal preparation of adjacent teeth (16). Other advantages of this type of prosthetic rehabilitation are the fact that it avoids the possibility of pulp trauma or subgingival preparation, the procedure is simpler, cheaper and requires less time for the patient in the dental chair (21). Despite the numerous benefits, this type of prosthesis is not indicated in some cases, such as in very decayed or restored teeth, teeth with some mobility or for patients with parafunctional habits such as bruxism (22,23).

The third alternative for prosthetic rehabilitation in these cases is the fixed partial denture, which consists of a type of prosthesis with preparation and cementation of full crowns in teeth adjacent to the missing tooth. However, for cases of maxillary lateral incisor agenesis, this type of prosthesis is the least recommended, as it involves a lot of tooth wear and risks of pulp involvement, in addition to having a higher cost for the patient (16). This rehabilitation is more indicated when the adjacent teeth need more extensive rehabilitation due to caries, fractures, or pigmentations (16).

Regardless the choice of rehabilitative

treatment, preprosthetic orthodontic treatment plays a fundamental role in planning these cases, as it provides the correct positioning of adjacent teeth and the space needed to replace the missing tooth. In addition, it favors good gingival positioning, ensuring satisfactory biological and aesthetic factors.

Use of mini-implants in preprosthetic dental traction

With the increase in the number of cases requiring prosthetic treatment with malocclusion, new alternatives have emerged in the orthodontic market aiming to address tooth repositioning, especially in adult patients (24). There are several forms of anchorage described in the literature, such as lingual and transpalatal bar, Nance's button, intermaxillary elastics and headgear. However, these options often present discomfort and low patient compliance, in addition to a long treatment time (25,26). Aiming at a simpler and faster treatment modality, other forms of intraosseous anchorage began to be studied, thus creating mini-implants.

Mini-implants are described as temporary anchorage devices, which are fixed to the alveolar bone via buccal and/or lingual/palatal. These devices are presented in the form of small screws composed of a biocompatible metal, such as titanium (25).

These temporary anchorage devices can be installed by an implant dentist or even an orthodontist, provided they are professionally trained. The main advantages of this treatment modality involve the reduced size — which brings little or no discomfort to the patient — ease of installation, high resistance to orthodontic forces, ability to receive immediate loading, if necessary, versatility in use with several possibilities of mechanical orthodontic applications, easy removal, and low cost (25). However, planning the placement of mini-implants must be done carefully to prevent these devices from reaching any vital organ, and clinical and radiographic examinations must be carried out to measure the space between the roots, the distance to the foramen, the main nerves and blood vessels (27).

The application of mini-implants as a

temporary anchorage device has numerous indications, which were detailed by Araujo et al. (25). Among them are anterior teeth retraction (especially in cases of posterior teeth absence that makes anchoring difficult), posterior teeth mesialization, incisor intrusion, posterior teeth intrusion, occlusal plane correction (intrusion of dental elements can present a complex mechanics that becomes much easier with the use of mini-implants), molar distalization, molar uprighting and disimpaction, posterior crossbite correction, and midline correction (25).

Soares et al. used the technique of uprighting a mandibular molar with a mini-implant in a complex and challenging case of an adult patient with several tooth absences, chronic periodontitis, malocclusion and opening of diastemas (28). The interdisciplinary treatment involved an initial phase of oral environment preparation with the aid of periodontics and surgery, eliminating foci of infection and restoring periodontal health. Then, the orthodontic treatment involved four steps: leveling and aligning the dental elements; creation of adequate spaces for prosthetic rehabilitation; uprighting of the lower third molar using a mini-implant anchored by a steel and NiTi hybrid spring; and creation of adequate protrusive and lateroprotrusive guides. After completion of the orthodontic treatment, implant-supported prostheses were placed in the regions of missing teeth and the necks of the anterior teeth were filled with resin, in order to minimize the aesthetic compromise caused by periodontal bone loss. Finally, the authors point out that interdisciplinarity and good planning were essential for the successful treatment of this case (28).

Despite success rates between 80% and 90% being described, mini-implants may fail in some situations or even be contraindicated in certain patients (26). One of the main problems encountered in mini-implant therapies is the loss of stability of the device, which may be caused by several factors, such as failure at the time of insertion, inadequate location, application of excessive orthodontic force, or due to peri-implant tissue inflammation, caused by poor hygiene (25, 26, 29).

In addition, other complications of therapy involve mini-implant contact with tooth root

surface, screw fracture or loss, development of peri-implantitis (or peri-implant mucositis) and traumatic mucosal injuries (25, 29). According to by Chang and Tsengde (2014), temporary anchorage devices are contraindicated in patients with healing or immune defense problems, hematological and coagulation disorders, poor bone quality and poor hygiene (26). Furthermore, the treatment may not be highly indicated for children and adolescents with mixed dentition and heavy smokers, whose inflammation rates can be quite high (26). Several authors also point out that to achieve higher success rates, mini-implants should be placed in the inserted gingiva, avoiding as much as possible the free gingiva, as this region has greater chances of inflammation and subsequent failure of the device (25, 29).

DISCUSSION

The search for smile aesthetics and functional rehabilitation by adults has grown a lot in recent years. As proof of this, Gorbunkova et al. (2016) showed the evolution in the number of scientific publications since 1965 that address multidisciplinary interventions, with the association of more than one modality in the search to achieve the best result for the patient (6). In addition, other authors stress the importance of a multidisciplinary treatment plan as a prerequisite for the satisfactory conclusion of rehabilitation treatments in patients, especially adults, with missing teeth and periodontal disease (1,19).

The literature does not demonstrate a fixed protocol for pre-prosthetic orthodontic treatment, and therefore the definition of the prosthetic rehabilitation treatment plan is of paramount importance and directly impacts the appropriate choice of orthodontic treatment to be adopted. However, Spear et al. determine that aesthetics should be prioritized over biological and functional aspects (1). Although this position may generate some strangeness, these last factors are not neglected, and their importance is equally highlighted by the authors (1).

Preprosthetic orthodontic treatment has several benefits described by several authors. Among them, the vitality preservation of

some teeth can be highlighted by reducing the need for wear for cementing fixed prostheses, periodontal recovery and gingival insertion, realignment of the occlusal plane, reducing the need for surgical interventions, as in cases of increased clinical crown or tooth extractions (1, 7, 9, 28). Therefore, orthodontic treatment often proves to be a more effective, cheaper, and more conservative alternative (11).

One of the rehabilitations in which the role of previous orthodontic treatment is most discussed is in the case of maxillary lateral incisor agenesis. Several authors discuss the forms of rehabilitation and, in most of them, the greatest benefit is found when the canine is pulled, being repositioned to the place of the lateral incisor, subsequently undergoing an adequate recontour (5,16). Kiliaridis et al. (2016) consider, in their review, that a patient who undergoes space closure by orthodontics has better periodontal health, with lower rates of biofilm and gingival bleeding. An alternative to consider in these cases is also the maintenance or, if necessary, the opening of a space between the central incisor and the canine for subsequent placement of a single implant (16). However, rehabilitation with implants must be very well studied and only performed at the right time, that is, after completion of bone development, to avoid cases of infra-occlusion of the implant (19).

According to recent studies, one of the best rehabilitation options is still the adhesive fixed bridge, as it is an alternative that presents less tooth wear, is not very invasive, has a reduced cost, in addition to showing very satisfactory aesthetic results (16, 21). As some cases have contraindications for this type of rehabilitation treatment (22, 23), another possibility is the fixed partial denture, which can achieve satisfactory aesthetic results, especially in patients whose anterior teeth present caries or extensive fractures (16). Although the choice of rehabilitative treatment may vary, pre-prosthetic orthodontic treatment is essential and guarantees the correct positioning of adjacent teeth or space needed to replace the missing lateral incisor. Among other benefits, this planning and prior treatment favor important biological and aesthetic factors to achieve the ideal result (3).

With the increasing demand of adult

REFERENCES

patients presenting difficult movements in the field of orthodontics, mini-implants emerged as movement facilitators (25). The authors agree that these temporary anchorage devices help significantly in the dental movement of molars that, due to their location at the end of the arch, do not allow adequate posterior anchorage by traditional methods for movements such as intrusion and uprighting of the tooth element (24, 28). The literature highlights that despite requiring caution at the time of installation due to the risk of affecting vital structures, the technique that uses the mini-implant has high success rates and has been widely recommended in clinical practice (25-27, 30).

Preprosthetic orthodontic treatment is already a highly relevant alternative, due to the increased demand for complex prosthetic rehabilitations by adult patients. In view of this, our study highlights its relevance in addressing topics that can contribute to the literature in elucidating treatment alternatives. Despite being a topic considered current and pertinent, the individuality of each patient means that the literature concentrates more case report articles, requiring more studies that concentrate protocols and indications for possible cases that may arise in clinical practice, helping the specialist in choosing the best treatment for the patient.

CONCLUSION

This work concluded, therefore, that orthodontics, being inserted in the stages of diagnosis and treatment plan of prosthetic rehabilitation, brings invaluable benefits in the search for an easier rehabilitation environment with greater guarantees of aesthetic and functional success, especially in more complex cases of dental absences and agenesis. The use of mini-implants is a current alternative for more punctual movements in a faster and more effective way.

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