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Review

Orthodontic extrusion for pre-implant site enhancement: Principles and clinical guidelines

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ABSTRACT

Purpose: The aim of this paper is to provide a concise overview about the principles of pre-implant orthodontic extrusion, describe methods and techniques available and provide the clinicians with guidelines about its application.

Study selection: A number of reports describe orthodontic extrusion as a reliable method for pre-implant site enhancement. However, no standard protocols have been provided about the application of this technique. The literature database was searched for studies involving implant site enhancement by means of orthodontic extrusion. Information about the principles, indications and contraindications of this method, type of anchorage, force and time were obtained from the literature.

Result: Despite that the scarce data is largely limited to case reports and case series, implant site enhancement by means of orthodontic extrusion seems to be a promising option to improve soft and hard tissue conditions prior to implant placement.

Conclusion: Orthodontic extrusion is being implemented as a treatment alternative to enhance hard and soft tissue prior to implant placement. While the current literature does not provide clear guidelines, the decision making for a specific approach seems to be based on the clinician's preferences. Clinical studies are needed to verify the validity of this treatment option.

Contents

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1. Introduction

The replacement of missing teeth by dental implants has proven to be a successful and a predictable treatment modality. Long-term clinical studies have shown excellent survival rates for implants placed in edentulous and partially edentulous jaws [1,2]. For single tooth replacement, a number of treatment protocols have been proposed with the goal to improve the esthetic and functional outcomes and to accelerate the overall treatment duration [3–6]. One of the available treatment options is immediate implant placement, which denotes the installation of the implant at the time of tooth extraction [7,8]. Nevertheless, immediate implant placement is indicated only in cases where soft and hard tissue conditions are considered ideal at the time of implant placement [4]. Here, it is well known that the majority of implant cases lack a sufficient quantity of soft tissue and underlying bone structure. The lack of these tissues is mainly due to site-specific anatomical limitations, namely a thin buccal plate [9–11]. Therefore, most implant procedures, such as immediate implant procedures in the esthetic zone, necessitate pre-implant, simultaneous and/or post-implant site enhancement procedures, specifically tissue augmentation procedures [12,13]. The ultimate goal of such procedures is to furnish a peri-implant tissue architecture that facilitates the establishment of close-to-nature functional and esthetic outcomes. For this purpose, several techniques and procedures have been proposed [14]. One of the suggested approaches is orthodontic extrusion. While this approach has been originally introduced to save traumatized teeth from extraction, it has been suggested as a method to manipulate soft and hard tissues via gradual extrusion of a ''hopeless'' tooth and its periodontal apparatus; thereby enhancing the predictability of the implant site [3]. A number of reports are available in the literature that describes orthodontic extrusion as a reliable method for pre-implant site enhancement [3,5,15]. However, no standard protocols have been provided about the application of this technique. An overview about orthodontic extrusion would enhance the knowledge about different techniques as well as provide the clinicians with guidelines that can aid in decision-making and application of this approach.

The aim of this review was to provide an overview about the principles of pre-implant orthodontic extrusion, describe methods and techniques available and provide clinicians with guidelines about its application based on the current evidence.

2. Orthodontic extrusion or orthodontic extraction?

For a successful orthodontic treatment, time and force are considered as important factors [16]. Based on these, the terms orthodontic extrusion and orthodontic extraction were extensively discussed in the literature and are summarized elsewhere in this paper [3,17,18]. The term ''orthodontic extrusion'' indicates coronal shifting of the entire attachment apparatus along with the tooth utilizing light eruptive forces [17,19,20]. Here, the gingival margin maintains the same relationship with the erupted tooth prior to and following extrusion [17]. The procedure is considered as a conservative exercise, where the dimensions of the attached gingiva and bone are increased [21]. Different terms have been used in the literature to describe orthodontic extrusion, such as ''controlled vertical extrusion'', ''forced eruption'' and ''slow eruption'' [22]. On the other hand, the term ''orthodontic extraction'' indicates coronal shifting of the tooth without the attachment apparatus and the crestal bone using ''high'' and ''rapid'' eruptive forces [17]. This results in a more coronally positioned tooth, with unchanged gingival margins at the pretreatment levels [22]. Orthodontic extraction is often used in the esthetic zone to coronally position cervical or subgingival caries, thereby bypassing the need for crown lengthening procedure that may compromise the esthetic outcome [23,24]. In contrast, orthodontic extrusion is indicated in cases where esthetics are a primary goal, such as achieving a harmonious gingival course [25]. In addition, it is indicated as a non-surgical approach to enhance soft and hard tissue architecture prior to implant placement [3]. For consistency and to avoid confusion, the term orthodontic extrusion will be used throughout this review.

3. Biological principles of orthodontic extrusion

Histologically, pressure and tension zones are distinguished in the areas where an orthodontic movement is active [16,26]. In the pressure zone, several biological events take place. These are characterized by disturbance of blood flow in the compressed periodontal ligament (PDL), followed by cell death, termed as hyalinization, as well as subsequent resorption of the hyalinized tissue by macrophages and resorption of the undermining bone through osteoclast activity, which eventually leads to tooth movement [27]. In the tension zone, stretching of the PDL activates blood flow,

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