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Interdisciplinary Therapeutic Approach in a Patient with a Maxillary Central Incisor with Severe Root Resorption and Gummy Smile: A Case Report

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Abstract

Introduction: Dental avulsion (DA) associated with delayed tooth replantation (DTR) frequently progresses to root resorption (RR), compromising esthetics and function in the anterior esthetic zone (AEZ) of the maxilla.

Objective: To describe the interdisciplinary management of tooth #21 with severe root resorption, treated with orthodontic treatment (OT), immediate implant (II) with immediate provisionalization (IP), and implant-supported prosthetic rehabilitation (ISPR).

Materials and Methods: A 26-year-old female patient with a history of DA and delayed replantation of tooth #21 ten years earlier. After completion of OT, atraumatic extraction was performed and a 4.5 × 13 mm internal-connection implant was placed with an insertion torque of 45 N·cm, followed by IP using the patient's natural crown adapted to an abutment (platform switching).

Subsequently, lip repositioning and gingivectomy procedures were performed for the management of a gummy smile, and the case was finalized with a metal-ceramic crown fabricated on a customized impression coping.

Results: After three years of follow-up, adequate osseointegration, stability of the marginal bone level, an adequate emergence profile, and a high rate of esthetic and functional satisfaction of the patient were observed, with no biological or mechanical complications. Conclusions: The protocol of II with IP, combined with OT and periodontal plastic surgery, constitutes a predictable alternative for the rehabilitation of teeth with severe RR in the AEZ when clinical conditions are favorable.

Keywords

Tooth replantation; Immediate implant; Dental avulsion; Root resorption; Periodontal plastic surgery.

Introduction

Dental avulsion (DA) represents the most severe traumatic injury within the spectrum of dentoalveolar trauma, as it involves the complete displacement of the tooth from its socket and the rupture of the periodontal ligament fibers. In this regard, the prognosis of delayed tooth replantation (DTR) depends critically on the extraoral time and the viability of the remaining cement oblasts and periodontal fibroblasts, which may favor dentoalveolar ankylosis and replacement root resorption (RR), processes that can gradually and irreversibly compromise the viability of the tooth. This outcome, which is foreseeable in the medium or long term, underscores the need to anticipate strategies that preserve the architecture of the alveolar ridge while the tooth remains in function [1].

In this context, orthodontic treatment (OT)acquires strategic value as a tool for bone preservation prior to eventual tooth loss. Controlled tooth movement stimulates physiological bone apposition around the root being displaced, favoring maintenance of ridge height and integrity of the buccal bone plate. Thus, OT is not limited to optimizing tooth position and interocclusal relationships; it also acts as a biological resource to condition the volume and quality of bone at the future receptor site, laying the foundation for predictable implant-supported rehabilitation (ISR) once extraction is indicated [2].

Once this objective has been achieved, immediate implant (II) placement after extraction, associated with immediate provisionalization (IP), is consolidated as the therapeutic alternative of choice for rehabilitating teeth with a compromised prognosis. By being placed in the same surgical session as the extraction, this protocol reduces the number of interventions, preserves bundle bone, and eliminates the edentulous period, although its predictability requires rigorous case selection, adequate primary stability (PS), and a three-dimensional implant position based on esthetic criteria. IP complements this approach by guiding soft tissue healing from day one, conditioning the emergence profile (EP) and preserving papillary volume throughout the osseointegration process [3].

However, the stability of peri-implant soft tissues is not always sufficient when the patient presents an associated gummy smile, a scenario in which periodontal plastic surgery (PPS) becomes indispensable to complete the esthetic result. Lip repositioning limits the traction of the upper lip elevator muscles and reduces gingival display during smiling, while gingivectomy allows leveling of the dental zeniths and establishment of a harmonious gingival contour between the natural dentition and the ISR [4].

In light of the above, the objective of this report is to describe the multidisciplinary management of a case of replacement RR secondary to DTR, rehabilitated by means of OT, II with IP, and PPS, with the aim of achieving a predictable esthetic and functional outcome in the AEZ.

Case Report

A 26-year-old melanodermic female patient presented to the Postgraduate Center in Dentistry of UniCPO/Bauru – Brazil, reporting progressive mobility of the maxillary left central incisor (#21), a situation that directly affected her quality of life and generated considerable esthetic, social, and psychological compromise (**Figure 1**).

Figure 1: Initial clinical situation

During the anamnesis, a history of severe dentoalveolar trauma occurring in 2016 secondary to a traffic accident was reported, which resulted in complete DA. The tooth remained approximately 24 hours outside the socket, stored in cow's milk as a storage medium, until the DTR procedure was performed and subsequently subjected to endodontic treatment, remaining in function for seven years. Clinical examination revealed integrity of the buccal and palatal bone plates, as well as of the interproximal bone crest, and a gummy smile with an adequate periodontal phenotype; however, periapical radiographic evaluation showed extensive replacement RR, a finding that determined an unfavorable prognosis for tooth conservation (**Figure 2**).

Figure 2: Periapical radiograph showing extensive replacement root resorption of tooth #21

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Based on the evidence and intra- and extraoral analysis, a treatment plan divided into three phases was proposed and accepted by the patient: in phase 1, OT with fixed appliances for 12 months would be performed, aimed at optimizing occlusion, harmonizing interdental spaces, stabilizing the bone, and preparing the receptor site for subsequent ISR; in phase 2, extraction of tooth #21 with subsequent placement of II with IP was planned in order to preserve bundle bone and gingival architecture, conserve the EP and interdental papilla, concluding with PPS for smile adaptation; in phase 3, definitive ISR of tooth #21 was chosen. This report describes the first stage of a sequential interdisciplinary treatment; a subsequent phase addressing complementary esthetic and functional aspects is currently under development and will be reported separately.

Once the orthodontic objectives were achieved, phase 2 was carried out. Terminal infiltrative and palatal anesthesia, complemented by infraorbital anesthesia, was administered using 4% articaine with epinephrine 1:100,000. Immediately thereafter, atraumatic extraction of tooth #21 was performed using forceps No. 151, with rotational luxation movements in a coronal direction, aimed at preserving the integrity of the alveolar walls, particularly the buccal bone plate. Curettage of the post-extraction socket was performed, and continuous drilling sequence for dental implant (DI) placement was carried out, together with an underdrilling protocol to optimize primary stability (PS), ensuring three-dimensional positioning of the DI in accordance with esthetic principles.

A Strong SW® internal-connection implant (S.I.N. Implant System, São Paulo, Brazil), measuring 4.5 × 13 mm, was placed at a depth of 3 mm relative to the gingival margin of the extracted tooth, oriented in a bucco-palatal direction toward the palatal bone plate. An insertion torque of 45 N·cm was obtained, providing sufficient PS to indicate IP. After placement of the II, a gap of approximately 2 mm was identified between the buccal surface of the implant and the corresponding bone plate; considering the adequate PS, the integrity of the buccal plate, and the correct implant position, it was decided to take advantage of the biological characteristics of the blood clot and not to use biomaterials to fill the gap, nor were soft tissue grafts used (**Figure 3**).

Figure 3: Gap (2 mm) between the buccal surface of the implant and the buccal bone plate.

In the same stage, a provisional restoration for IP was fabricated from the buccal face of the coronal portion of the extracted tooth, which was ground, polished, and adapted with acrylic resin to a 3.8 mm diameter titanium provisional abutment, smaller than the implant diameter, generating a platform switch oriented to preserve the EP, support the peri-implant soft tissues, and guide gingival healing from

the initial phase of osseointegration. The provisional prosthesis was installed and screwed without occlusal contacts (non-functional loading).

Subsequently, the patient was referred to the periodontics service of the same unit for performance of PPS, which consisted of upper lip repositioning by resection of a strip of mucosa from the upper vestibule and tissue approximation, with the aim of limiting the traction of the upper lip elevator muscles and reducing gingival display during smiling. In a second surgical time, gingivectomy of the upper arch was performed, from the incisors to the premolars, with the objective of leveling the zeniths of the natural teeth with that of the implant-supported restoration and establishing a harmonious and symmetrical gingival line (**Figure 4**).

Figure 4: Immediate postoperative view of periodontal plastic surgery (upper lip repositioning and gingivectomy).

After five months, and once maturation of the tissues was completed, an adequate peri-implant emergence profile was confirmed (**Figure 5**), and phase 3 of ISR was undertaken. The EP obtained by means of the provisional restoration was recorded and transferred with a customized open-tray impression coping using Pattern Resin® (**Figure 6**), which ensured stability during impression taking and faithfully preserved the peri-implant morphology. Based on this record, a definitive metal-ceramic crown was fabricated in the laboratory. After its installation and the corresponding occlusal and proximal adjustments, stable occlusion without interferences was achieved, as well as harmonious esthetic integration in color, shape, and contour with the adjacent teeth.

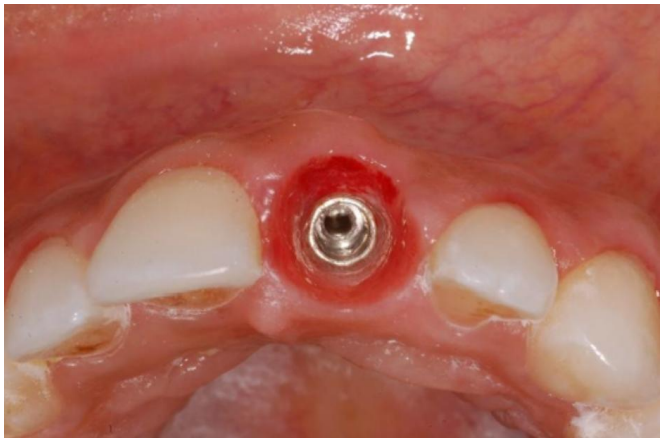

Figure 5: Satisfactory emergence profile of tooth #21.

Figure 6: Recording of the emergence profile with a customized impression coping using Pattern Resin®

After three years of follow-up, through radiographic and tomographic evaluations, adequate osseointegration, absence of peri-implant radiolucency, marginal stability, and maintenance of the buccal bone plate can be evidenced, highlighting the presence of bone above the implant platform, a finding compatible with favorable bone remodeling (**Figure 7**). Clinically, the soft tissues showed harmonious contours, a stable EP, and adequate peri-implant health, with no biological or mechanical complications during follow-up (**Figure 8**).

Figure 7: Tomographic evaluation showing adequate peri-implant bone volume

Figure 8: Final clinical situation after 3 years of follow-up

Discussion

This case report describes the ISR of a maxillary left central incisor affected by RR secondary to DTR, by means of a sequential approach that integrated OT, II with IP, and PPS for the management of the

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associated gummy smile, in a patient whose quality of life was compromised by the esthetic, social, and psychological sequelae of the dentoalveolar trauma suffered ten years earlier.

The replacement RR with which the patient presented constitutes the foreseeable sequela of a DA followed by a DTR, evidenced years later through clinical and radiographic examination, confirming the biological scenario predisposed from the initial trauma; nevertheless, the permanence of the tooth in function for seven years should be interpreted as a favorable outcome within an initially unfavorable biological context. Some studies have confirmed this association, reporting an incidence of RR of approximately 51% after replantation of avulsed teeth (5). In this sense, the guidelines of the International Association of Dental Traumatology (IADT) reinforce that, in cases of DTR (such as the 24-hour case of the present report), the expected outcome is precisely ankylosis and progressive RR, although the tooth may remain functional for several years, especially in young adult patients, allowing preservation of the alveolar ridge until definitive treatment is indicated [6].

Faced with a compromised dental prognosis in the medium term, OT acquired strategic value in this case as a tool for alveolar ridge preservation prior to extraction. This approach is consistent with that described by Salama and Salama, who demonstrated that controlled orthodontic movement of teeth with an unfavorable prognosis allows stimulation of bone apposition and conservation of soft tissues, transforming a compromised site into a favorable receptor for subsequent DI placement [7].

The decision to perform atraumatic extraction of tooth #21 with subsequent placement of an II is supported by solid evidence. Chen and colleagues describe that the II preserves bundle bone and reduces post-extraction bone remodeling (8), while Buser and colleagues indicate that, in esthetic sites, this protocol is predictable provided that adequate PS is achieved and a palatalized three-dimensional implant position is respected (9). In the present case, an insertion torque of 45 N·cm was obtained and the implant was positioned 3 mm apical to the gingival margin, in contact with the palatal bone plate, fulfilling both requirements and also allowing a reduction in the number of surgical interventions and elimination of the patient's edentulous period.

Management of the gap between the buccal surface of the implant and the corresponding bone plate constitutes a controversial point in the implant literature. While classic protocols recommended systematic filling with biomaterials (10), the studies of Botticelli and colleagues demonstrated that, in implants placed in a palatalized position, with an intact buccal plate and a gap equal to or less than 2 mm, favorable spontaneous bone remodeling occurs, mediated by the organization and maturation of the blood clot, without the need for grafts (11). In our case, having identified a gap of approximately 2 mm and verified the integrity of the buccal plate and adequate PS, it was decided to take advantage of the biological characteristics of the clot rather than use filling biomaterials, a decision subsequently supported by the tomographic finding of bone tissue above the implant platform during the follow-up period.

IP, fabricated from the patient's own natural crown and adapted by means of the platform-switching concept, was decisive for the esthetic success of the case. This is also reinforced by Kan and colleagues, who highlight the relevance of immediate provisionalization with a customized contour because it

stabilizes the buccal gingival margin and prevents collapse of the interdental papilla (12). The use of a provisional abutment of smaller diameter than the implant also allowed generation of a favorable biological space, guiding the healing of the peri-implant soft tissues and conditioning a natural EP from the initial phase of osseointegration, without exposing the patient to an edentulous period or compromising the immediate esthetic result. These findings are reinforced by Nami and colleagues, who support the use of platform switching as a strategy to improve implant stability and long-term outcomes, highlighting its potential to enhance clinical practices in implantology [13].

Management of the gummy smile by means of lip repositioning and gingivectomy should not be underestimated, since esthetics in contemporary implantology depends as much on the dental restoration as on the surrounding gingival harmony. Dawadi and colleagues describe lip repositioning as an effective technique to limit the traction of the upper lip elevator muscles and reduce gingival display during smiling [14], while Chu and colleagues highlight that leveling of the dental zeniths and obtaining a stable gingival contour are fundamental for the implant-supported restoration to integrate naturally with the remaining dentition [15]. In this case, the sequential combination of both PPS techniques allowed harmonization of the gingival line of the upper arch and enhancement of the esthetic result achieved with definitive ISR.

The three-year follow-up constitutes one of the main strengths of this report, evidencing absence of peri-implant radiolucency, stability of the marginal bone level, and health of the soft tissues, findings that confirm the medium- and long-term predictability of the protocol employed. It is undeniable that the sequential integration of OT, II with IP, and PPS allowed a highly satisfactory esthetic and functional result to be obtained in a case that was initially unfavorable due to post-traumatic RR, and we consider that, when clinical conditions are favorable, this type of multidisciplinary approach based on scientific evidence constitutes a predictable alternative for rehabilitation of the AEZ. It should be noted that this case represents the first part of a broader sequential treatment plan; additional procedures performed in a second stage will be presented in a subsequent report.

Conclusion

The treatment of teeth with RR by means of OT, II, and IP constitutes a predictable and effective alternative for rehabilitation of the AEZ. Primary stability, three-dimensional implant position, and adequate management of the soft tissues are determining factors for treatment success, while the integration of PPS procedures optimizes the final esthetic result. Three-year follow-up evidenced peri-implant bone and gingival stability, as well as a high degree of patient satisfaction, supporting the long-term predictability of this protocol.

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Ethics committee statement

Ethics approval was not required for the preparation of this case report.

Data availability statement

No new data were generated or analyzed in this study. Data availability is not applicable to this article.

informed consent statement

Written informed consent was obtained from the patient for the publication of her clinical information and images, ensuring confidentiality and anonymity in accordance with the Declaration of Helsinki.

Conflict of interest

The authors declare that they have no conflicts of interest.

Author contributions

V.S.M.R., A.I.B.R., and R.O.A.J. contributed to the clinical management of the patient. M.A.M. and E.J.F.T. contributed to data collection and literature review. V.F.C.P. performed the original writing of the manuscript. All authors have read and approved the final version of the manuscript.

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