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Nine-year Follow-up of Autotransplantation in the Maxillary Anterior Region: Replacing a Fused Incisor with a Supernumerary Tooth

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ABSTRACT

The goal of tooth autotransplantation is to restore a missing tooth by using a functional tooth from the same patient. Although this procedure is gaining more recognition as a viable treatment option in dentistry, it is important to monitor and report long-term results. This case report presents the long-term follow-up of a fused maxillary central incisor that was extracted and replaced with a supernumerary tooth. Although the donor tooth displayed favorable characteristics, including an intact periodontal ligament and minimal extraoral time, which contributed to the success of the transplantation, it also presented certain disadvantages, such as having a fully developed root apex. Over a 9-year follow-up period, no clinical symptoms indicative of functional failure were observed. However, external cervical root resorption, first detected at the 6-year follow-up, progressed by the ninth year. Despite the lack of clinical symptoms, radiographic findings suggested that the root resorption was a significant concern. This case underscores the potential for long-term success of autotransplanted teeth, even in complex scenarios involving fused teeth. However, it also highlights the importance of thorough, long-term monitoring to detect complications such as root resorption. The findings suggest that, while autotransplantation can offer favorable outcomes, careful management and periodic evaluations are essential to ensure the longevity of the transplanted tooth. *(J Endod 2025;51:781–787.)*

KEY WORDS

Autotransplantation; case reports; endodontics; fused tooth; supernumerary tooth

SIGNIFICANCE

This case highlights autotransplantation as a viable long-term solution for replacing missing teeth, even in complex cases involving fused teeth, while emphasizing the importance of regular follow-up to identify complications like external root resorption that may affect tooth longevity.

Dental fusion is a rare developmental anomaly characterized by the union of 2 or more independently developing tooth germs at the dentin level, resulting in the formation of a single, enlarged tooth during odontogenesis, prior to the completion of crown mineralization[1]. Although its etiology remains incompletely understood, factors such as physical pressure exerted by adjacent tooth follicles, as well as genetic and racial predispositions, are believed to play a pivotal role[2]. The clinical presentation of fused teeth varies depending on the developmental stage at which the anomaly occurs. Typically, a fused tooth exhibits a large, bifid crown with a groove or incisal notch demarcating the coronal structures of the 2 fused teeth. In most cases, the dental arch displays a reduced tooth count, typically by one, unless fusion involves more than 2 teeth or includes supernumerary teeth[1-3]. The extent of the anomaly may be confined to the crown or encompass both the crown and the roots, depending on the stage of development during fusion. While fused teeth are often asymptomatic, intervention may be warranted in cases of compromised aesthetics, dental caries, periodontal pathology, and/or pulp necrosis[1,4,5]. Effective management necessitates a multidisciplinary approach, incorporating surgical, orthodontic, periodontal, endodontic, and restorative strategies tailored to the specific clinical context.

Supernumerary teeth, also known as hyperdontia, represent an anomaly characterized by the formation of additional teeth beyond the normal complement, arising from disruptions during the initiation and proliferation phases of odontogenesis[6,7]. While the exact etiology remains unclear, a combination of genetic and environmental factors is believed to contribute[8-10]. Supernumerary teeth may occur as part of a syndromic presentation or as an isolated phenomenon, sometimes linked to familial inheritance

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patterns. Most cases, however, arise sporadically[10]. Their prevalence is approximately 10 times higher in the maxilla compared to the mandible, with the maxillary anterior region accounting for nearly 90% of single supernumerary teeth[7,10]. The presence of supernumerary teeth can lead to various complications, including delayed or failed eruption of permanent teeth, displacement of adjacent teeth, crowding, root resorption of adjacent teeth, dentigerous cyst formation, dilaceration, ossification of the pericoronal space, and crown resorption[6,10,11]. Management typically involves extraction of the supernumerary tooth, with the surgical approach tailored to its size, shape, number, and the patient's dental developmental stage[10,11].

Autotransplantation is a surgical procedure involving the repositioning of a tooth from its original site to another location within the same individual, providing a biological replacement for a lost, damaged, or traumatized tooth[12,13]. This treatment modality offers a versatile solution, accommodating the needs of patients across various age groups. Autotransplantation is indicated in diverse clinical scenarios, including impacted or ectopically positioned teeth, premature or trauma-induced tooth loss, tooth loss secondary to tumors or iatrogenic factors, congenital tooth absence, orthodontic malocclusions, teeth with poor endodontic or restorative prognosis, developmental dental anomalies, and/or cleft lip and palate[13-15]. In pediatric and adolescent populations, autotransplantation is particularly valuable for addressing maxillary anterior teeth that are frequently affected by trauma, caries, periodontal disease, or developmental anomalies. Unlike dental implants, which may impede alveolar development in growing patients, autotransplanted teeth provide a functional and vital periodontal attachment and harmonize with the eruption process of adjacent teeth[14,16,17]. The success and survival of an autotransplanted tooth depend on numerous factors, including the stage of root development, apical opening dimensions, management of bone and periodontal tissues, adherence to surgical, endodontic, and orthodontic protocols, splinting techniques, pharmacologic support, and timing of treatment. Key determinants of success include employing meticulous surgical techniques during tooth extraction, minimizing extra-alveolar time, and preventing exposure of the root to irritants. These factors collectively enhance the prognosis and longevity of the transplanted tooth[13,18,19].

This case report presents the comprehensive treatment approach and 9-year follow-up outcomes of a pediatric patient presenting with a fused permanent central incisor and a supernumerary tooth in the maxillary anterior region. The treatment plan involved the extraction of the fused permanent central incisor, followed by the autotransplantation of the supernumerary incisor into the appropriate site. Subsequently, the patient underwent a multidisciplinary treatment protocol, encompassing endodontic, orthodontic, and restorative interventions, to ensure functional and aesthetic rehabilitation.

CASE DESCRIPTION

A 9-year-old male patient was referred to the pediatric dentistry clinic with the chief complaint of an unaesthetic appearance of his front teeth when smiling. The patient had no history of systemic diseases, congenital anomalies, syndromes, or previous dental treatments. Furthermore, according to the anamnesis obtained from the patient's parents, there was no record of craniofacial or dental trauma.

Intraoral examination revealed a supernumerary and incisor-form tooth located between the maxillary right permanent central and lateral incisors. In the maxillary left central incisor region, a fused incisor was identified, characterized by a mesiodistally widened crown and a notch at the incisal third of the crown. The maxillary right permanent canine had not yet erupted, whereas approximately two-thirds of the crown of the maxillary left permanent canine was visible. The maxillary right permanent lateral incisor was rotated, while the left counterpart was displaced palatally. Additionally, the supernumerary tooth in the maxillary right anterior region was rotated along its long axis and exhibited a crossbite relationship (Fig. 1*A–C*). Further examination revealed crowding in both the maxillary and mandibular anterior regions. The overbite rate was 70%, with an overjet of 2 mm. The patient exhibited a bilateral Angle Class I molar relationship and was in the early permanent dentition phase. Oral hygiene assessment indicated poor hygiene, with significant dental plaque accumulation on all teeth. Gingival evaluation confirmed a diagnosis of gingivitis.

The intraoral findings were corroborated through radiographic examination. A panoramic radiograph revealed 2 distinct pulp horns within the crown of the fused incisor, located on either side of the incisal notch (Fig. 2*A*). A single, large root canal was observed within a common root structure, ruling out the feasibility of hemisection in the treatment plan. Given the anatomical form of the supernumerary incisor and its mesiodistal width compatibility with the dental arch, autotransplantation of the supernumerary incisor was planned to follow the extraction of the fused incisor.

The proposed treatment plan was thoroughly explained to the patient and his parents, and their informed consent was obtained. During the initial session, a Nance holding arch was planned to maintain the recipient site for the transplanted tooth and to facilitate orthodontic management during the treatment process. Impressions of both the maxillary and mandibular arches were taken using irreversible hydrocolloid impression material (Hydrogum 5; Zhermack, Badia Polesine, Italy). Impressions of the mandibular arch were taken for 2 key purposes: first, to evaluate the interarch relationship on the plaster model, and second, to design a removable appliance for the lower jaw to prevent occlusal contact between the transplanted tooth and the opposing arch postautotransplantation. The surgical procedure was scheduled for 1 week later, and the patient was prescribed a prophylactic antibiotic regimen (amoxicillin/clavulanic acid; Augmentin ES 600/42.9 mg, GlaxoSmithKline, UK; 2 × 1) to be followed during the interim period.

In the second session, a Nance holding arch with molar bands (Narrow Contoured Molar Bands; 3M Unitek, California, USA) was cemented onto the maxillary right and left first permanent molars using luting glass ionomer cement (Meron Plus; VOCO, Germany) (Fig. 1*D*). Additionally, a Hawley appliance with an occlusal bite plane extending over the right and left premolars was fabricated and placed. Given the patient's cooperation, the surgical procedure was performed under local anesthesia. Buccal and palatal infiltration anesthesia was administered to the fused permanent central incisor and the supernumerary incisor using 4% articaine with 1:200,000 epinephrine (Ultracain D-S; Sanofi-Aventis GmbH, Frankfurt, Germany). The fused central incisor was gently extracted first, followed by the careful extraction of the supernumerary incisor, with special attention to preserving the integrity of its radicular structure. The entire surgical procedure lasted 30 minutes, with the interval between the extraction of the supernumerary incisor and its transplantation into the extraction socket of the fused tooth being less than 2 minutes. Stabilization of the transplanted supernumerary incisor was achieved using semi-rigid fixation with stainless steel wire and composite resin during the same session (Fig. 1*E–K*). Postoperative care included prescribing antiseptic and disinfectant spray (chlorhexidine; Corsodyl 0.2%, GlaxoSmithKline, UK; 2 × 1), anti-inflammatory (ibuprofen; Dolven 100 mg/5 ml,

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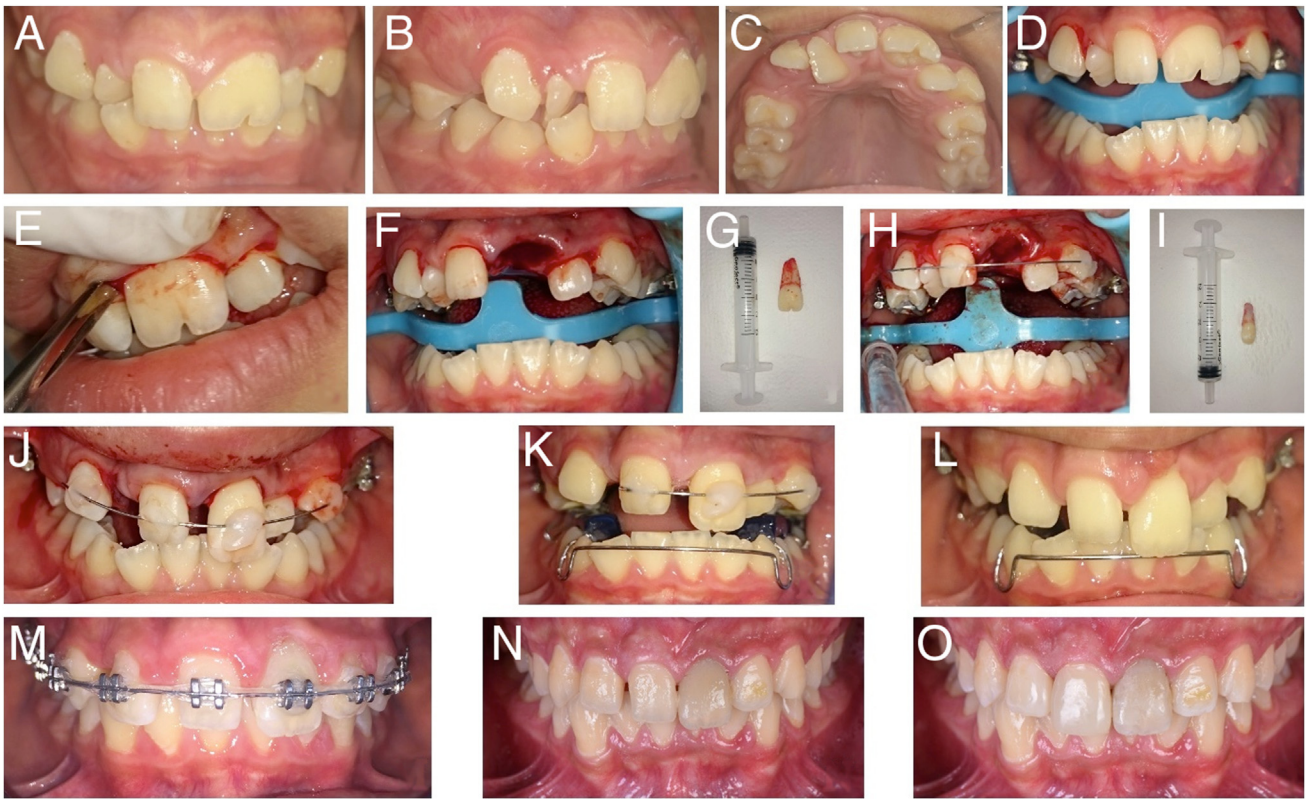


FIGURE 1 – Treatment progress of the 9-year-old boy with a maxillary fused left central incisor and right supernumerary tooth. (*A–C*) Pretreatment intraoral photographs. (*D*) Intraoral photograph with Nance appliance. (*E–I*) Extractions of the fused and supernumerary teeth. (*J–L*) Transplantation of the tooth, the semi-rigid fixation, and removable appliance for occlusal adjustment. (*M*) Orthodontic alignment. (*N* and *O*) Intraoral photographs of restoration renewal 9 years after the transplantation.

Sanofi, France; 3 × 1) for pain management, and amoxicillin/clavulanate (Augmentin ES 600/42.9 mg, 2 × 1) as an antibiotic regimen for 1 week. The patient and his parents were provided with detailed oral hygiene instructions and dietary recommendations to ensure optimal healing.

As the transplanted supernumerary incisor exhibited mature root development, root canal treatment was initiated 2 weeks after transplantation, following the removal of the semi-rigid splint (Figs. 1*L* and 2*B–C*). Access cavity preparation was performed under water cooling using a high-speed handpiece (NSK, Nakanishi Inc, Japan). The root canal was prepared using Wave One Gold (Dentsply Maillefer, Ballaigues, Switzerland) primary file (size 25, .07 taper) activated in a VDW Gold Reciproc motor (VDW, Munich, Germany), at the RESIPROC ALL setting, adjusted for reciprocating motion at 350 rpm speed. The file was used with a short up-and-down motion with minor apical pressure in 3 cycles, one to prepare each third of the canal (coronal, middle, and apical) using an ethylenediaminetetraacetic acid-containing gel (EDTA; Cerkamed, Stalowa Wola, Poland) as a

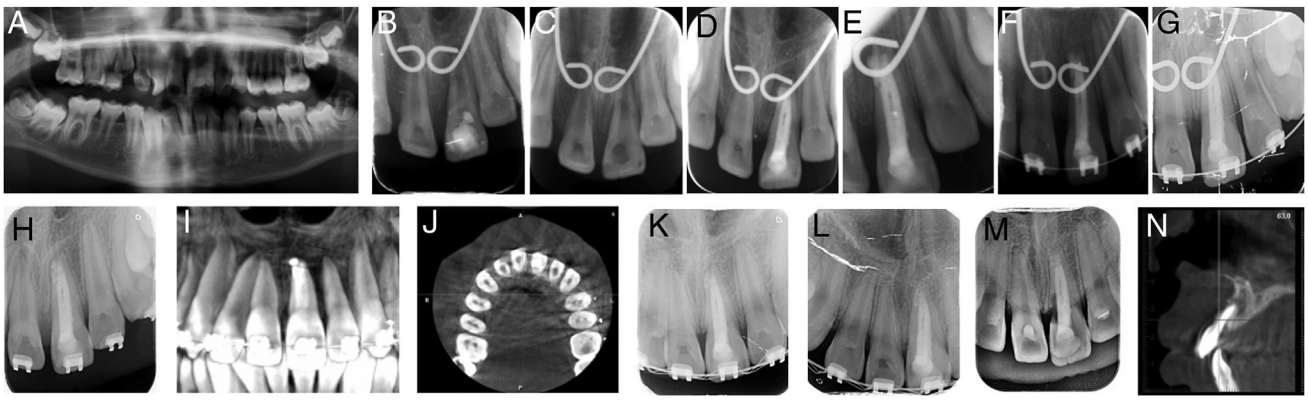


FIGURE 2 – (*A*) The initial panoramic radiograph. (*B–D*) The root canal treatment procedure of transplanted tooth. (*E–H*) Follow-up periapical radiographs of 1, 9, 12, and 18 months after transplantation, respectively. (*I* and *J*) 21-month follow-up cone-beam computed tomography images. (*K–M*) Follow-up periapical radiographs of 2, 3, and 6 years after transplantation, respectively. (*N*) The axial cone-beam computed tomography image of 9-year follow-up.

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lubricant. The canal was irrigated with 1.5 ml of 5.25% sodium hypochlorite (NaOCl) (Chloraxid, Cerkamed, Stalowa Wola, Poland) after each cycle, using a 27-gauge needle. Final irrigation was performed with 0.9% sterile saline solution (Geno Technology, St. Louis, USA). The canal was then dried using absorbent paper points (Dentsply International, York, PA, USA). Calcium hydroxide dressing (Kalsin; Aktu, Izmir, Türkiye) was applied as an intracanal medicament, and the patient was scheduled for a follow-up 14 days later. During this period, the patient continued to use the mandibular removable appliance to prevent occlusal contact with the transplanted tooth. At the follow-up appointment, the temporary restoration (Cavit G; 3M ESPE, Germany) was removed, revealing purulent discharge from the canal. The canal was re-irrigated with NaOCl, dried with paper points, and re-dressed with calcium hydroxide. The patient was scheduled for an additional follow-up after 14 days. At the subsequent appointment, no adverse symptoms were reported, indicating clinical improvement. The root canal was irrigated with 5.25% NaOCl and sterile saline, then dried using paper points. No exudate flow was observed during the procedure. The root canal was subsequently filled with mineral trioxide aggregate (MTA-Angelus; Angelus, Brazil) using endodontic pluggers (GDC, India) with an incremental technique. To allow the MTA to set, it was covered with a moist cotton pellet and a temporary filling (Cavit G) for 24 hours. At the subsequent appointment, the upper portion of the root canal, filled with MTA up to 3 mm below the cemento-enamel junction, was restored with conventional glass ionomer cement (Ionofil; VOCO GmbH, Cuxhaven, Germany) (Fig. 2*D*–*E*). The coronal restoration involved etching with 37% orthophosphoric acid (Scotch Bond Etchant; 3M ESPE, Seefeld, Germany), followed by the application of a universal adhesive (Scotchbond Universal; 3M ESPE, Seefeld, Germany), cured with a light-emitting diode curing light in soft-start polymerization mode (Celalux 2 High-Power light-emitting diode Curing Light; VOCO GmbH, Cuxhaven, Germany). A composite resin (A1, Gradia; GC, Tokyo, Japan) was used for restoration, with incisal adjustments confirmed using articulating paper. Polishing was completed with composite polishers (Shofu, Tokyo, Japan).

Orthodontic treatment initiated 9 months later, and fixed appliances were installed to improve leveling and alignment. Progressive nickel titanium arch wires (Sia Orthodontic Manufacturer S.r.l.; Rocca D'Evandro, Caserta, Italy) and elastic chains (Ortho Technology; Lutz, Florida, USA) were used in the upper dental arch to close remaining interdental spaces (Figs. 1*M* and 2*F*–*G*). Normal occlusal relationships were obtained at the end of treatment, besides good facial and acceptable smile harmony and normal speech and swallowing. The patient was scheduled for periodic follow-ups at predetermined intervals of 3, 6, 9, 12, 15, 18, 21, and 24 months, transitioning to annual check-ups until the third year (Fig. 2*H*–*J*). During the first 3 years, the transplanted tooth remained stable and free of complications (Fig. 2*K* and *L*). At the sixth-year follow-up, initiation of the external root resorption was noticed at the cervical third of the root (Fig. 2*M*). Although cervical root resorption was observed radiographically at the mesial cemento-enamel junction border of the affected tooth, no clinical symptoms were present including no tenderness to the palpation or percussion. The patient and their parents were informed about the relevant complications and treatment options. They stated that they had no complaints and expressed their preference to continue with routine follow-up visits. However, the patient did not attend any follow-up appointments for 3 years. The patient was finally reached at the 9th year follow-up. Even though the patient and his parents reported no complaints, clinical and radiographic evaluations revealed several findings. Tooth discoloration was present in the transplanted tooth due to the MTA, alongside a noticeable size discrepancy among the maxillary anterior teeth (Fig. 1*N*). Cone-beam computed tomography revealed ongoing root resorption on the mesial side of the transplanted tooth, although there was no evidence of clinical symptoms (Fig. 2*N*). Additionally, the white spot lesion on the buccal surface of the maxillary left lateral incisor, which had developed following orthodontic treatment, had turned to a yellowish spot without cavitation. During the appointment session, the patient confirmed the absence of any discomfort or functional issues related to the affected teeth. Due to the progression of external root resorption in the affected tooth, creating a connection between the root surface and the root canal, an option of implant insertion was offered for the concerned region. However, as the patient and his parents reported no complaints, and contented with his teeth, they expressed no desire for surgery and postponed the implant procedure. It was decided to temporarily restore the maxillary central teeth to address the size discrepancy issue for a better esthetics. A monochromatic composite restoration was performed without tooth preparation. The button technique was employed for shade selection. After isolating the teeth with a rubber dam, the surfaces were cleaned using air polishing (Aquacare; Velopex, London, England). The enamel surfaces were etched with 37% orthophosphoric acid for 30 seconds, followed by the application of a universal adhesive (G-Premio Bond; GC, Japan). A monochromatic layering technique was utilized with the selected "body" shade composite resin (A1B, Estelite Asteria; Tokuyama, Japan). Composite was carefully applied to the mesial surface of the lateral incisor and the distal and incisal surfaces of the central incisor using the free-hand technique. The restorations were refined with finishing and polishing using spiral polishers (DiaComp Plus; EVE, Germany) (Fig. 1*O*). Final outcome was satisfactory for the patient and his parents, and they were encouraged for yearly visits.

DISCUSSION

Autotransplantation presents a viable alternative in cases where implants or prosthodontic solutions are either impractical or contraindicated, particularly in young patients or individuals facing financial limitations[4]. The reported survival rates for autotransplanted teeth vary widely, ranging from 60% to 98%. For instance, Cohen et al[20] observed a 10-year survival rate of 60%–95% for transplanted anterior teeth with fully developed roots. Andreasen et al[21], in a 13-year longitudinal study involving 370 autotransplanted premolars, documented a remarkable long-term survival rate of 95%–98%. In the study by Kvint et al[22], which evaluated the long-term clinical success of 215 autotransplanted teeth, the success rate was reported to be 81%, with failures typically observed around the 2.4-year mark on average. In the present case, a clinically acceptable outcome was achieved over the 9-year period. However, radiographically, external cervical root resorption, first detected in the sixth year, progressed by the ninth year, indicating that the tooth had become a candidate for extraction.

The success of autotransplantation is contingent upon multiple factors, including patient-related variables, the characteristics of the donor tooth, the condition of the recipient site, atraumaticity of the extraction procedure, and the clinician's expertise[23]. Optimal outcomes are typically achieved in younger, healthy, and cooperative patients who maintain adequate oral hygiene[24]. Ideal donor teeth possess specific features, such as an intact periodontal ligament, minimal extraoral exposure time, root development at approximately 3-quarters to four-fifths

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completion, apical foramina exceeding 1 mm in diameter, and a single, cone-shaped root morphology[16]. In the present case, the donor tooth exhibited several favorable attributes, including an intact periodontal ligament, a single cone-shaped root structure, and an extraoral time of less than 2 minutes postextraction. These factors significantly contributed to the overall success of the procedure. However, certain challenges were also encountered, such as the patient's suboptimal oral hygiene and the fully developed root of the donor tooth—an age-related characteristic. These limitations introduced potential risks to the long-term prognosis of the transplanted tooth.

Studies have demonstrated that young, immature permanent teeth with open apices possess sufficient blood supply and stem cells to facilitate pulp revascularization following transplantation[14,17,25]. This regenerative process occurs through the ingrowth of vascularized connective tissue into the pulp cavity or the anastomosis of transplanted dental blood vessels with periodontal blood vessels[14]. As a result, autotransplantation of immature permanent teeth is widely considered a preferred treatment option for children and adolescents. This approach not only promotes pulp vitality through revascularization but also preserves aesthetics by maintaining the natural contour of the attached gingiva[26]. On the other hand, regardless of whether the transplanted tooth is mature or immature, the integrity and healing of the periodontal ligament are pivotal for the procedure's success[19]. A healthy periodontal ligament facilitates bone regeneration, reduces the risk of severe complications such as root resorption, and allows for effective orthodontic movement during subsequent treatment phases[14,19]. In the present case, the fully matured apex of the transplanted donor tooth rendered pulpal revascularization unfeasible. Consequently, root canal treatment was initiated 2 weeks post-transplantation, and the canal was filled with MTA, a biocompatible and highly effective material for preserving tooth integrity[27,28]. The preservation of periodontal ligament health depended on several critical factors, including adequate pre-transplant bone support, minimal extraoral time during the procedure, and atraumatic surgical extraction performed by an experienced clinician[29,30]. Despite these precautions, external root resorption was observed in the transplanted tooth after 9 years of follow-up, although the patient remained asymptomatic. This resorption was likely multifactorial in origin, with contributing factors including suboptimal oral hygiene and mechanical forces exerted during orthodontic treatment—both of which are known to negatively affect periodontal ligament integrity. An additional determinant of periodontal ligament health is the adaptation of the donor tooth's root surface to the extraction socket. Although achieving a perfect fit is challenging, compatibility between the root morphology of the donor tooth and the recipient site is advantageous[31]. In this case, the root of the fused tooth was both mesiodistally and buccopalatally wider than that of the donor tooth. This morphological discrepancy may have compromised the adaptation of the donor tooth to the surrounding bone, potentially affecting the health and long-term integration of the periodontal ligament.

Various methods and materials have been proposed for stabilizing transplanted teeth, including orthodontic brackets, ligatures, sutures, composite resins, and, in specific cases, frictional stabilization between adjacent teeth[1]. Lundberg and Isaksson[32] emphasize the importance of nonrigid fixation for a period of 7–14 days, as this approach supports bone healing and promotes the proliferation of periodontal ligament cells. Consistent with these recommendations, a semirigid fixation was applied to the maxillary arch in the present case for a duration of 2 weeks following the autotransplantation procedure.

Several studies have investigated the short- and long-term complications associated with autotransplanted teeth. Andreasen et al[21] examined tooth survival and pulp healing following autotransplantation, reporting that pulp canal obliteration occurred in nearly all immature teeth that showed positive responses to pulp testing. Additionally, their findings indicated that the use of antibiotics both preoperatively and postoperatively significantly reduced the incidence of root resorption in mature teeth. Accordingly, in the present case involving a mature donor tooth, antibiotics were prescribed preoperatively and postoperatively. Andreasen et al[33] also reported that surface resorption occurred in 4.6% of transplanted teeth, typically localized in the cervical region of the root and diagnosed within the first-year post-transplantation. Inflammatory resorption, observed in 4.6% of cases, was commonly identified 1–2 months after the procedure and strongly associated with the stage of root development, often coinciding with pulp necrosis. Furthermore, replacement resorption (ankylosis) was detected in 4.8% of transplanted teeth, with diagnosis generally occurring within the first year following transplantation. Lundberg and Isaksson[32] monitored 278 autotransplanted teeth over an average of 6 years, reporting that only 3% of teeth with open apices exhibited various forms of root resorption, compared to 20% of teeth with closed apices, which presented resorption at different sites and in varying forms. Similarly, a systematic review and meta-analysis[15] revealed that teeth with open apices at the time of transplantation have a significantly lower risk of ankylosis, pulp necrosis, and root resorption compared to teeth with closed apices. Consistent with the literature, external root resorption was observed in the present case during the sixth-year follow-up, predominantly in the cervical region of the transplanted tooth.

CONCLUSION

In this case, a fused maxillary central incisor was extracted and replaced with a supernumerary tooth, which demonstrated better dimensional compatibility with the recipient site. Over the 9-year follow-up period, no adverse clinical symptoms indicative of functional failure was observed. However, cervical external root resorption, initially detected in the sixth-year follow-up, showed progression by the ninth year.

This case underscores the potential for achieving long-term success and functionality with autotransplanted teeth, even in complex clinical scenarios involving fused teeth. It also highlights the critical need for meticulous long-term follow-up to monitor complications such as root resorption, particularly in cases with morphological and periodontal challenges. The findings suggest that, with comprehensive planning, precise execution, and diligent patient management, autotransplantation remains a valuable treatment modality, even in demanding clinical situations.

ETHICS

Written consent for publication regarding the treatment and follow-up processes and the use of images was obtained from the patient and his parent.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

In writing this paper, ChatGPT-4 software was used only to check grammar and spelling rules. After using this tool, the authors reviewed and edited the content and takes full responsibility for the content of the publication.

ACKNOWLEDGMENTS

The authors deny any conflicts of interest related to this study.

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