Autotransplantation of an inverse impacted dilacerated incisor: a case report with 11-year follow-up

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Abstract

Background Dilaceration can lead to impaction of maxillary incisors, resulting in both aesthetic and functional problems. This case report presents the multidisciplinary approach to managing an inverse impacted dilacerated left lateral incisor in a 9-year-old male patient.

Case report The orthodontic alignment of the remaining three incisors was achieved within six months. After using the diode laser to remove the gingiva covering the right lateral incisor during alignment process, a lingual button was bonded. The primary left canine and the impacted permanent left lateral incisor were extracted by raising the full-thickness mucoperiosteal flap, followed by the transplantation of the dilacerated lateral incisor into its correct position, splinted to the adjacent central incisors using composite resin. Root canal treatment was performed after the apical plug was created with mineral trioxide aggregate. The composite splint was removed after three weeks, and a new bracket was bonded to the left lateral incisor. It was left passively for 18 months until the permanent canines started to erupt. Light orthodontic forces were then applied for six months, and a passive eruption was expected over three months to properly position the canines within the dental arch. After an 11-year follow-up, the incisor displayed no clinical symptoms, although radiographic examination revealed external resorption in the long-term.

Conclusion This case demonstrates the successful and fast autotransplantation of an immature inverse impacted dilacerated incisor, highlighting the long-term clinical success and favorable aesthetic outcomes.

KEYWORDS Autotransplantation, Dental trauma, Dilaceration, Impacted.

Introduction

The eruption of permanent incisors can be influenced by various factors, including both systemic conditions such as endocrine disorders and syndromes, as well as local factors like the presence of supernumerary teeth, ankylosis, odontogenic tumors, and maxillofacial trauma [Shi et al., 2021]. A noteworthy factor for eruption failure of incisors is dilaceration.

Lyu et al. [2018] indicated that approximately 66% of impacted incisors exhibit a dilaceration angle exceeding 20 degrees. Although the aetiology of dilaceration is not yet fully understood, it is linked to factors such as traumatic dental injuries (specifically avulsion or intrusion), ectopic development, periapical infection, ankylosis, transplantation, or extraction of the predecessor primary teeth may contribute to its occurrence. Local traumas can induce deviation or angulation, forming an angle in the calcified part of the successor tooth germ [Chew and Ong, 2004; Jafarzadeh and Abbott, 2007]. If a permanent tooth germ experiences local trauma before the age of three, angulation or deviation can be seen at the crown level, and at the root level if it is exposed between three to five years of age [De Amorim et al., 2018].

When permanent incisors remain impacted, their natural eruption becomes challenging due to adjacent teeth drifting into the space, and the intricate positions of dilacerated teeth [Yavuz et al., 2023]. Furthermore, inverse impacted teeth may not spontaneously erupt, deviating from their normal eruption pattern [Singh et al., 2018]. Treatment options for impacted dilacerated incisors include orthodontic traction after surgical exposure or extraction of the impacted incisor [Yavuz et al., 2023]. Several case reports in the literature describe surgical repositioning of impacted dilacerated incisors [Tsai, 2002; Adlakha et al., 2011; Shi et al., 2021]. Spontaneous eruption after surgical repositioning or orthodontic traction of an impacted tooth poses challenges due to the abnormal root formation and compelling position of the tooth [Pavlidis et al., 2011; Celli et al., 2015]. To the best of our knowledge, only a case report as a technical note in the literature presents the autotransplantation of an impacted dilacerated incisor [Maia and Vieria, 2005]. The outcome of present autotransplantation offers the longest successful follow-up in the literature. Moreover, it may provide information and potential for improvement for clinical applications by showing that the result of autotransplantation may change in long-term follow-up.

This case presents an eleven-year follow-up of a patient after the tooth transplantation for an inverse impacted

dilacerated incisor resulting from traumatic dental injury in childhood. This case report was prepared according to the CARE 2017 Guideline [Riley et al., 2017].

Case report

A 9-year-old male patient was referred to the Department of Pediatric Dentistry at Marmara University with disturbed maxillary incisor eruption as the chief complaint. Clinical examination and medical history revealed no systemic disease/syndrome or family history, although dental history indicated a bicycle accident a few years ago during full primary dentition years, resulting in facial and dental trauma. Upon initial examination, the right and left maxillary permanent central incisors had erupted, with the crown of the left central incisor oriented towards the vestibular side. Both maxillary lateral incisors had not yet erupted. The patient exhibited an Angle Class I molar relationship bilaterally and was in the late mixed dentition phase. Digital panoramic radiographs were taken with Morita device (VeraView IC5, J. Morita MFG. Corporation, Kyoto, Japan — operating parameters: 60–70 kV, 7.5 mA, 8.8 sec), cone-beam computed tomography (CBCT) were taken with Planmeca ProMax® 3D Mid unit (Planmeca Oy, Helsinki, Finland — operating parameters: 90 kV, 5.6 mA, 13.5 sec). The panoramic and periapical radiographs revealed that the right lateral incisor was located below the gingiva and the maxillary left lateral incisor was positioned parallel to the horizontal plane. The CBCT was used to see detailed tooth positions, and it was noticed that the upper left lateral incisor was actually in an inverse position with severe dilaceration, angled at 90 degrees, and root malformation.

The treatment plan involved aligning the remaining three incisors and performing a tooth transplantation procedure to reposition the left maxillary lateral incisor within the dental arch. The plan was thoroughly explained to the patient and the parents, and after obtaining their assent, informed consent was obtained from the parents. The photographs and radiographs of the patient at the baseline and before the autotransplantation were presented in Figure 1.

A Nance appliance was cemented onto the first molars to provide additional anchorage during orthodontic treatment. Brackets (Supertech, Sia Orthodontic Manufacturer, Caserta, Italy) were only attached to fully erupted maxillary permanent teeth, the alignment and leveling of permanent teeth were initiated with fixed orthodontic appliances (Figure 2). Initially, the central incisors were repositioned using 0.014-inch stainless steel arc wires. During the treatment period, new brackets were bonded to the newly erupted teeth. A diode laser (Gigaa Laser, China — 810 nm, 2.5 W) was applied to facilitate the eruption of the maxillary right lateral incisor in pulsed mode with a 400 µm fiber tip to remove the gingiva covering the incisor. A lingual button was bonded to the labial side of the incisor for orthodontic traction. Complete alignment of three incisors was achieved within six months.

Following the complete repositioning of three incisors, a full-thickness mucoperiosteal buccal flap was raised surgically with local anaesthesia to expose the inverse impacted left lateral incisor. Both the left maxillary permanent lateral incisor and primary canine were extracted. The crown of the incisor was held with forceps for less than a minute during an extraoral period. No preparation was performed for the recipient socket following the surgical extraction procedure. The dilacerated incisor was then transplanted into the right position and splinted to the adjacent central incisors using composite resin. Two weeks later, the splint was retained for an additional week, as the incisor was luxated during evaluation. After creating an apical plug using mineral trioxide aggregate (Angelus, Londrina, PR, Brazil), root canal treatment was performed in a single session without a rubber dam. The composite splint was removed after three weeks, and a new bracket was bonded to the left lateral incisor. The patient was followed-up for 18 months until the canines naturally erupted, with the use of arc wire and brackets on the four incisors. Alignment with light forces was performed for six months to prepare the space of the left maxillary canine. When sufficient space was created, the Nance appliance was removed, and the brackets on the posterior teeth were debonded. After waiting three months for complete canine eruption, the brackets in the anterior region were also debonded. A removable appliance was placed as a retainer and a fluoride varnish (MI Varnish, GC, America, USA) was applied to each tooth. Figure 3 displayed photographs and radiographs of the autotransplantation procedure and the treatment results.

Regular check-ups were scheduled at 1, 5, 9, 12, 18, and 24 months, followed by six-month or annual check-ups until the fourth year. In the 11th year, the patient was recalled for clinical and radiographical examination. No symptoms were observed, and the patient remained satisfied during the four-year follow-up. At the end of the fourth year, CBCT showed adequate alveolar bone formation around the maxillary left lateral incisor, with minor resorption around the root apex. In the 11th year, radiographs and CBCT revealed that external resorption had progressed a bit further. Alveolar bone height did not change over the years; however, new bone formation was also not observed. It was decided to continue surveillance of the resorption for a while longer. Periapical radiographs of the incisor after transplantation were presented in Figure 4. The restoration was renewed due to new enamel caries. The patient exhibited poor general periodontal health, but acceptable gingival contours due to inadequate oral hygiene. Oral hygiene instruction was provided, initial periodontal therapy was performed, and fluoride varnish (MI Varnish, GC, America, USA) was applied to each tooth.

Discussion and conclusion

The present case report highlights the successful long-term outcome of autotransplantation in a patient with an inverse impacted dilacerated incisor resulting from childhood traumatic dental injury. The treatment approach involved a series of carefully planned steps, including surgical extraction of the impacted incisor, autotransplantation into the appropriate position in the dental arch, and subsequent orthodontic alignment.

Managing cases of dilacerated impacted incisors presents intricate and multifaceted challenges, necessitating a comprehensive and interdisciplinary approach [Maia and Vieria, 2005; Celli et al., 2015]. Various treatment options have been proposed for impacted incisors in the literature. In cases of dilaceration, extraction of the affected incisor followed by space closure with a prosthesis or implant is considered a last resort. Alternatively, spontaneous eruption or orthodontic traction, following the surgical exposure of the incisor can be attempted [Chew and Ong, 2004; Yavuz et al., 2023]. There are also a few case reports in the literature that describe in situ rotation of the dilacerated incisor [Adlakha et al., 2011; Shi et al., 2021] or autotransplantation following surgical extraction [Maia and Vieria, 2005].

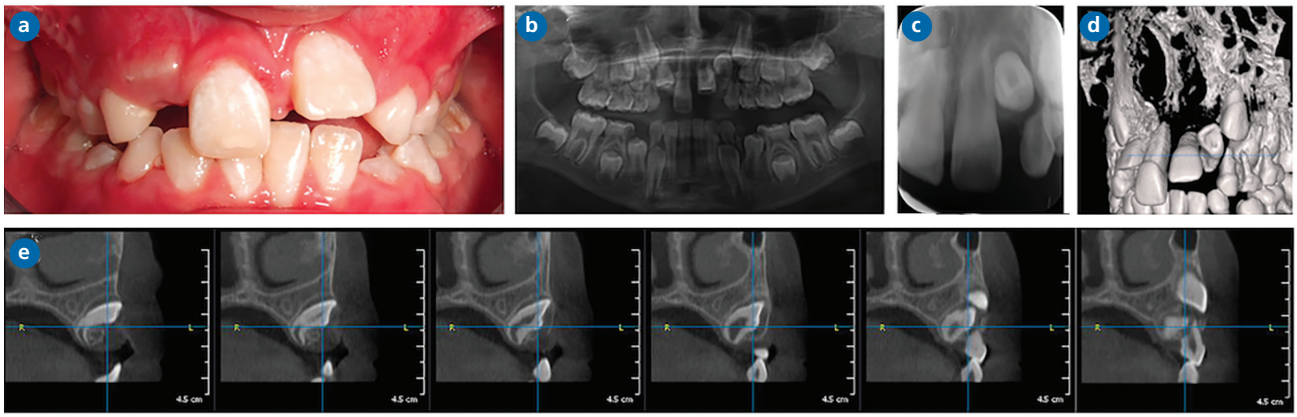

FIG. 1 Initial and pre-autotransplantation treatment. (A) The initial intraoral photograph. (B) The initial panoramic radiograph. (C) The initial periapical radiograph. (D) Three-dimensional reconstructed images of CBCT. (E) The axial CBCT images.

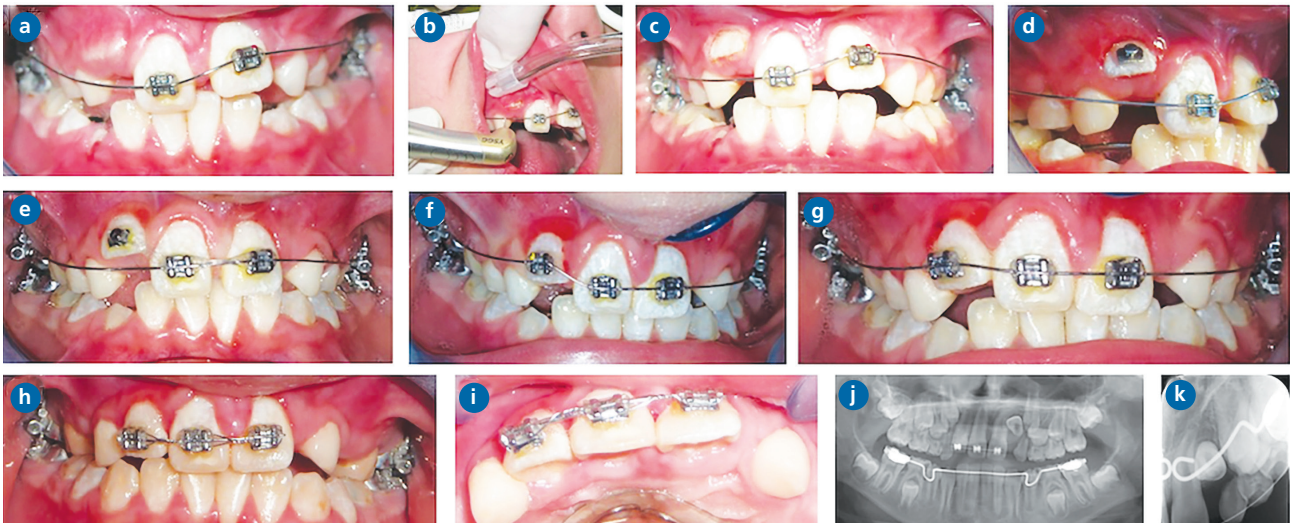

FIG. 2 The orthodontic alignment before autotransplantation. (A) Initial of the orthodontic alignment. (B) – (C) Diode laser application for exposing the right lateral incisor into the mouth. (D) The attachment of the lingual button to labial side of the right lateral incisor. (E) – (G) The orthodontic alignment of three incisors. (H) – (I) The intraoral photograph before the autotransplantation procedure. (J) The panoramic radiograph before the autotransplantation procedure. (K) The periapical radiograph before the autotransplantation procedure.

Orthodontic traction of dilacerated impacted incisors is associated with potential complications such as inflammatory resorption, root apex exposure, and ankylosis [Pavlidis et al., 2011; Bhikoo et al., 2018; Singh et al., 2018; Shi et al., 2021]. Factors such as inverse position and high degree of dilaceration contribute to longer treatment durations due to the increased bone remodeling necessary for eruption [Bhikoo et al., 2018; Yavuz et al., 2023].

The majority of case reports and studies in the literature on autotransplantation primarily focus on tooth transplantation from one group to the recipient site of another group (e.g., transplantation of premolars instead of incisors or third instead of first molar) [Barendregt et al, 2023]. To the best of the author's knowledge, this case report presents the longest-term results of autotransplantation for an impacted dilacerated incisor. Studies [Adlakha et al., 2011; Shi et al., 2021] describing the in situ rotation of impacted dilacerated teeth have been entitled to surgical repositioning. However, in the current case, unlike others [Adlakha et al., 2011; Shi et al., 2021], the incisor was repositioned in its optimal location within the dental arch, similar to the case reported by Maia and Vieria [2005], which is why the case was classified as autotransplantation.

Autotransplantation has demonstrated a high success rate for the replacement of missing teeth [Maia and Vieria, 2005; Tsukiboshi et al., 2019]. The presence of at least half of the root and immature tooth, marginal gingiva, minimising extraoral time, and preserving the periodontal ligament are important factors for successful autotransplantation [Maia and Vieria, 2005; Oleszkiewicz and Emerich, 2015]. A study investigating the transplantation of premolars reported that root development was completed in only 22% of immature teeth, partial development in 60%, and no development in 18%. Root canal treatment is required in teeth whose root development of the incisor was nearing completion [Maia and Vieria, 2005]. In the current case, root canal treatment was preferred as the root length of the incisor was completed with parallel ends. In addition, the short duration of the surgical procedure, as the extraction and transplantation were performed at the same site, likely contributed to reduced risk

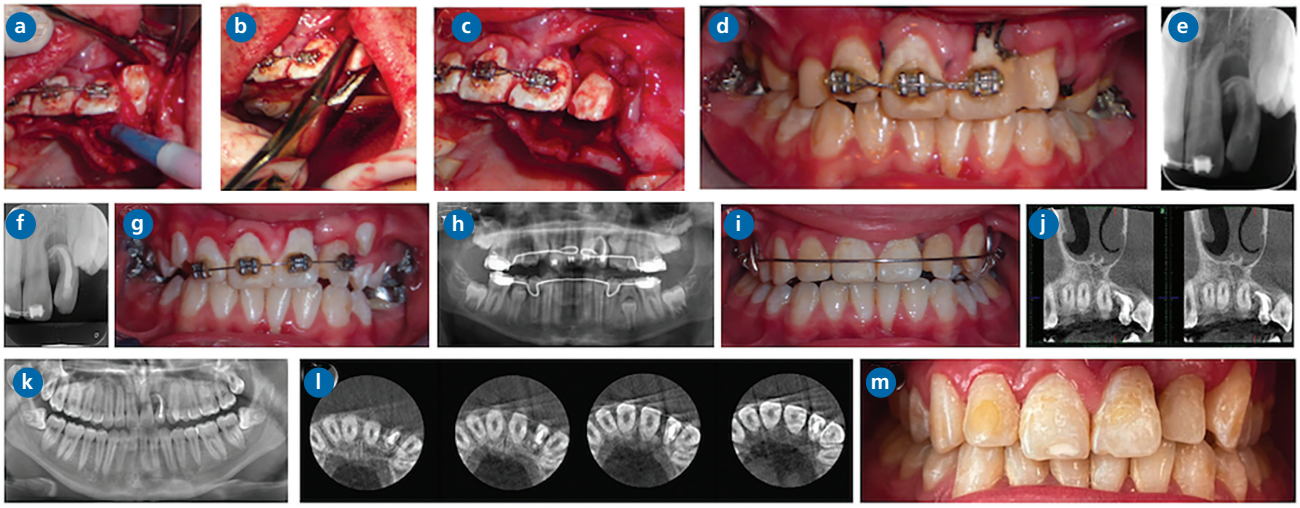

FIG. 3 The autotransplantation procedure and orthodontic alignment. (A) Surgical exposure of the impacted tooth. (B) Transplanting the incisor into the right position. (C) Immediately after the transplantation. (D) Splinting of the lateral incisor to adjacent central incisors using composite resin. (E) The periapical radiograph after the transplantation. (F) Periapical radiograph of the root canal treatment. (G) The starting of the eruption of permanent canine. (H) Panoramic radiograph one year after the transplantation. (I) Post-treatment intraoral photograph and use of the removable appliance for retention. (J) The sagittal CBCT images in the fourth year. (K) Panoramic radiograph 11 years after the transplantation. (L) The coronal CBCT images in the 11th year. (M) Intraoral photograph after restoration renewal in the 11th year.

of bone loss [Maia and Vieria, 2005]. However, no new bone formation was observed in this case.

Autotransplantation offers a relatively fast and cost-effective treatment option. One disadvantage is the need for crown modification with composite resin restorations or porcelain crowns for aesthetic and occlusal adjustments [Maia and Vieria, 2005; Tsukiboshi et al., 2019]. However, these modifications are especially necessary for transplantation of premolar or molar teeth, as it is often preferred for autotransplantation, or for incisors with crown malformation due to childhood trauma [Jafarzadeh and Abbott, 2007; Tsukiboshi et al., 2019]. In the present case, this disadvantage was eliminated as the incisor was transplanted into its own place. Additionally, a single surgical area did not require the preparation of the recipient socket, allowing the transplantation to be completed in approximately one minute. This approach may be best suited for the mixed dentition period when dentoalveolar tissues are still growing. Alternatively, it can be performed with socket preparation in adolescents or young adults. Patient cooperation is crucial for optimal treatment outcomes and sedation or general anaesthesia may be necessary, particularly in paediatric patients, if adequate cooperation cannot be achieved during the highly sensitive surgical procedure [Fllippi et al., 1998].

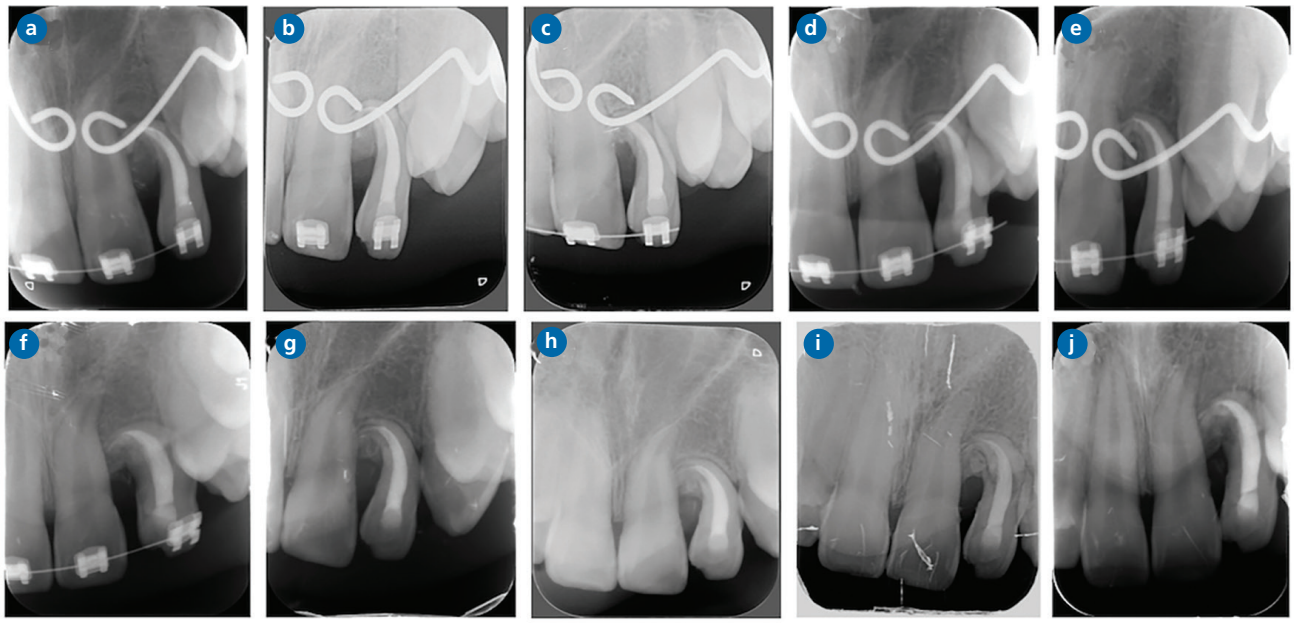

FIG. 4 Follow-up periapical radiographs (A) at the first month, (B) at the fifth month, (C) at the ninth month, (D) at the 12th month, (E) at the 18th month, (F) at the 24th month, (G) in the third year (H) in the third and half year, (I) in the fourth year, (J) in the 11th year.

However, in the current case, the procedure was performed under local anaesthesia due to the patient's positive cooperation.

Autotransplantation carries risks such as internal and external resorption, pulp calcification, and ankylosis [Shi et al., 2021]. However, these risks are also present in the orthodontic traction of dilacerated teeth following surgery [Yavuz et al., 2023]. The option of autotransplantation preserves the alveolar bone for further treatments such as implants, even in cases where the treatment has failed [Shi et al., 2021]. The root resorption in this case, which began in the fourth year, exhibited slight expansion in the 11th year. Although root resorption is an inevitable outcome [Becker, 2022], long-term survival can be predicted due to the slow resorption pattern seen from year four to year 11. Furthermore, Filippi et al. [1998] reported vertical bone loss after transplantation of an Al_2O_3-ceramic or titanium post-cemented donor tooth following root resection. This emphasises the importance of preserving the periodontal ligament. In the present case, the bone level remained stable even 11 years after transplantation, possibly due to the short extraoral time and preservation of the periodontal ligament by holding only the crown of the incisor with forceps during the extraoral period.

There are two case reports in the literature reporting the in situ rotation of the dilacerated incisor, enabling transplantation without extraoral exposure [Adlakha et al., 2011; Shi et al., 2021]. Shi et al. [2021] reported that the root development of the immature incisor continued after in situ rotation. While this treatment approach has the advantage of being performed intraorally compared to autotransplantation, a disadvantage is that the tooth is usually repositioned in a semi-erupted position, resulting in a longer orthodontic alignment period after surgery. Further studies are needed in the literature to evaluate the amount of bone loss associated with these two treatment protocols for dilacerated impacted incisors.

This case report demonstrates the clinically successful outcome and 11-year follow-up of autotransplantation of an inverse impacted dilacerated incisor in a 9-year-old patient. The use of the incisor itself, which should be in the recipient socket for the transplantation procedure, may have contributed to the favorable esthetic and periodontal outcomes. The presence of initial resorption in the long term underscores the importance of long-term follow-up after autotransplantation.

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