



Premolar transplantation to replace a missing central incisor

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During childhood, the anterior maxilla is susceptible to injury, and the loss of incisors is one of the most serious injuries. In many cases, autotransplantation is the best alternative for children who lose an incisor during the growth phase. This case report describes the treatment of a boy who had a traumatic injury when he was 8 years old that resulted in avulsion of the maxillary right central incisor. When he sought treatment at age 10, the space was lost as was bone in the incisor region. Because he lacked space in the mandibular arch for proper tooth alignment, extractions were planned. One extracted premolar was transplanted into the space of the missing maxillary incisor area. The posttreatment results were good, and follow-up records 7 and 9 years after treatment showed healthy periodontal support and cortical bone gain in the transplanted tooth's buccal area. (*Am J Orthod Dentofacial Orthop* 2015;147:394-401)

The incisor root development phase coincides with the period of childhood in which trauma occurs frequently in the anterior maxilla.¹⁻⁵ During this age, tooth avulsion occurs because the incisor roots are still growing and do not have good bone implantation.³ However, there are situations where the trauma is of such a magnitude that reimplantation is not possible. Consequently, treatment becomes limited because it is contraindicated to place dental implants or other restorative treatment while the patient still has the potential for alveolar growth.⁶

The transplantation of immature premolars has become a viable method for restoring edentulous areas because they can maintain the function and preserve the alveolar crest; this is advantageous for young patients when compared with dental implants that are static and do not erupt to compensate for future growth.⁷⁻⁹

The success of autotransplanted teeth is associated with periodontal ligament healing, no root resorption, bone and gum healing, and pulp and root development. To maintain this sequence of factors, atraumatic surgery is fundamental, and multidisciplinary participation is necessary to allow for a functional and esthetic restoration.³

Recent advances in computerized tomography have allowed for the visualization of structures that were impossible to evaluate in the past. Through these new technologies, the visualization of the periodontal ligament and new bone formation has become a reality.

This case report presents the autotransplantation of a premolar to the region of a central incisor through surgery with preservation of the periodontal ligament. The receiver site exhibited considerable bone resorption because tooth loss occurred 2 years before the initiation of treatment. The preservation of dental structures (cementum and periodontal ligament) allowed for bone formation around the transplanted tooth. This finding was possible only with the use of 3-dimensional tomography as a means of observation.

DIAGNOSIS AND ETIOLOGY

A 10-year-old boy was evaluated with the chief complaint of esthetic concerns (Figs 1-3). He was missing a maxillary central incisor, which had been lost in a traumatic injury at age 8. He was physically healthy but had active caries, a sinus tract in the maxillary left central incisor, and decay reaching the pulp of the maxillary right first premolar. Because of

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All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.

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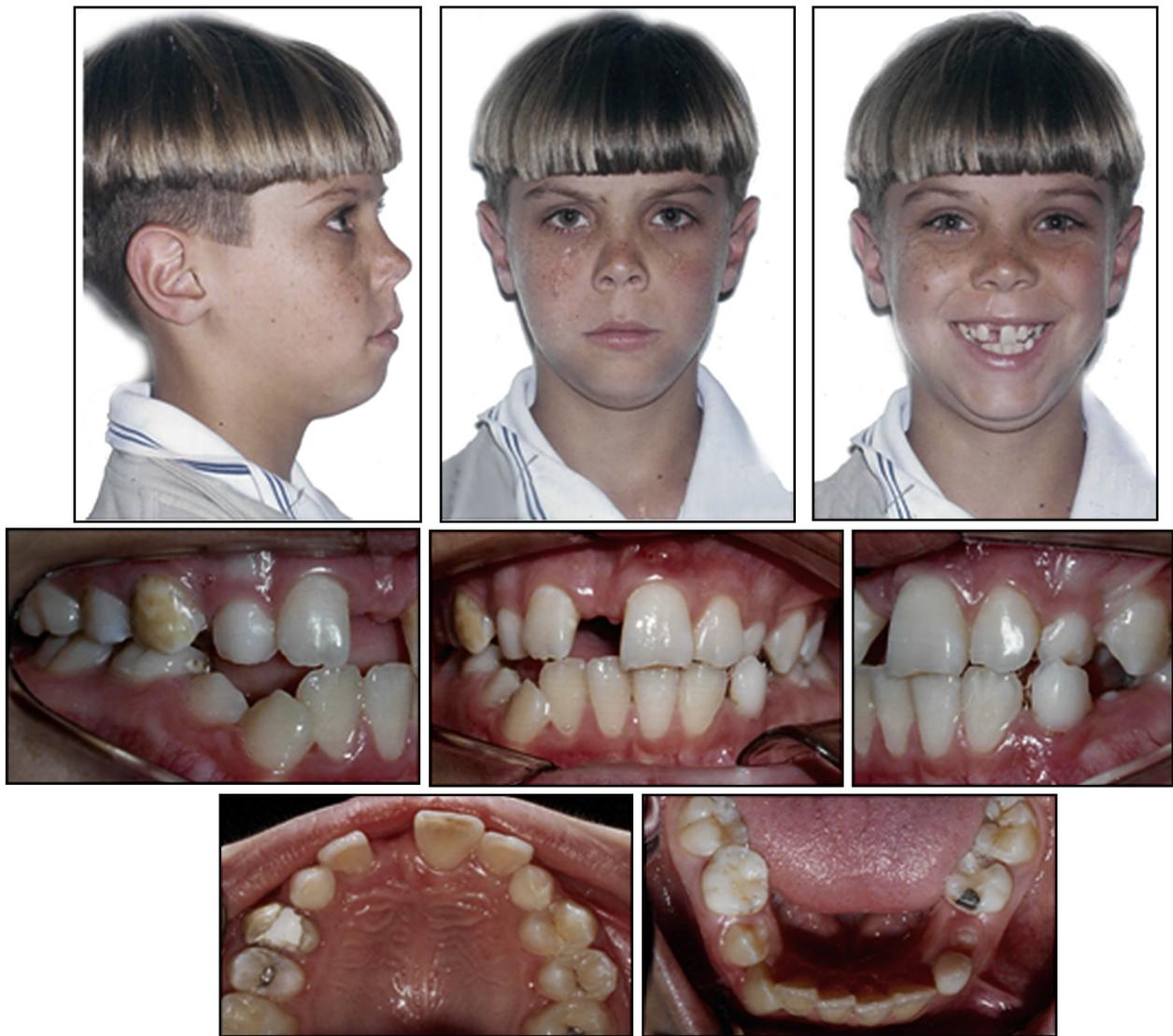


Fig 1. Initial extraoral and intraoral photographs.

the loss of the maxillary right central incisor 2 years earlier, the alveolar crest was atrophic because of the large amount of bone resorption. He had a posterior crossbite, crowding in the mandibular arch with a discrepancy of -8 mm, and an Angle Class I malocclusion and a Class II skeletal pattern (ANB, 7°) (Table).

TREATMENT OBJECTIVES

The goals of treatment included orthodontic alignment and leveling of the arches, obtaining a Class I relationship of the canines and molars, maintaining a normal contour of the marginal gingiva and bone for the transplant, correcting the posterior crossbite, and closing all spaces created by the dental extractions.

TREATMENT ALTERNATIVES

One treatment option was extraction of the maxillary left central incisor, which already had an associated sinus tract and was also traumatized. This would create space for the proper alignment of the maxillary arch. The central incisors would be replaced by the maxillary lateral incisors, which would be moved mesially; thus, the subsequent teeth would move consecutively. In the mandibular arch, the first premolars would be extracted to align and level the teeth without the additional projection of the incisors. After orthodontic treatment, some prosthetic treatment would be needed. The disadvantages of this course of treatment included excessive orthodontic movement and maintenance of the maxillary right

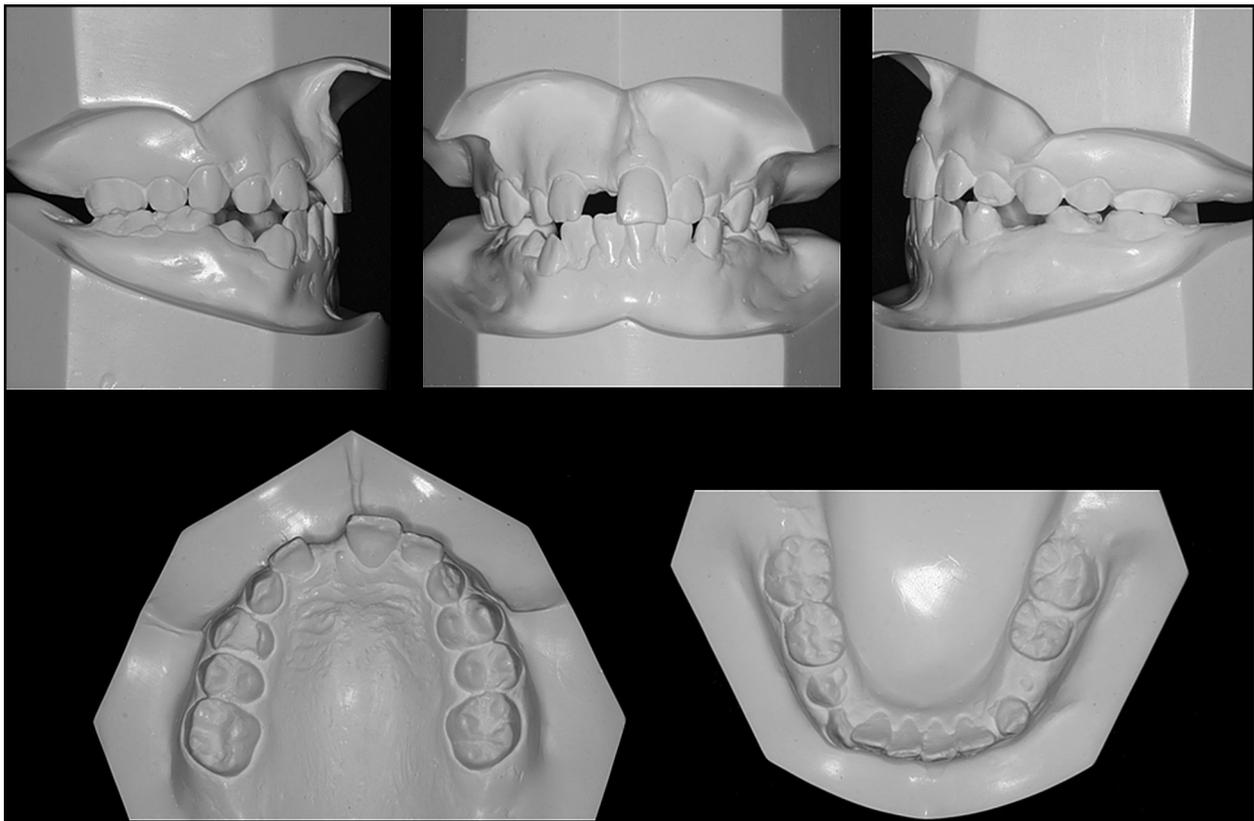


Fig 2. Initial dental casts.

first premolar, which had a poor prognosis. In addition, the anterior esthetics would be questionable because of the emergence profile of the lateral incisors, which was different from that of the central incisors. The canines' Class I relationship would not be achieved, and lateral movements would have to be performed in group function. Finally, the movement of the maxillary right lateral incisor to the position of the right central incisor would present an excessive risk of recession because of bone deficiency in the region caused by the early loss of this tooth.

Another alternative treatment was extraction of the first premolars to obtain adequate space for the alignment of both arches. Thus, the teeth would be aligned and space maintained for dental implant placement in the maxillary right central incisor region after the completion of the vertical growth of the maxillary alveolar process. The advantages of this treatment included extraction of the right first premolar, which had pulpal involvement. The disadvantages included difficulty in providing a definitive resolution to the problem of the absence of the incisor. The condition

of the area for placement of the implant would be poor because early tooth loss also results in bone loss, thereby generating the need for a surgical graft to obtain a satisfactory esthetic appearance of the gingiva.

However, the chosen treatment was endodontic therapy of the maxillary left central incisor, extraction of the maxillary first premolars, and maxillary expansion. In addition, we assembled 4 × 2 mechanics to make room for the transplant of the mandibular right second premolar to the maxillary right central incisor region, since this tooth had the ideal apical development.

All treatment options would achieve ideal Class I molar relationship and overjet. However, the patient and his parents wished for him to have a beautiful smile with good esthetics and function. The risk of root resorption from the transplant was understood and accepted by the patient and his parents.

TREATMENT PROGRESS

Once the discrepancy on the mandibular arch reached –8 mm, tooth extraction was inevitable, and to

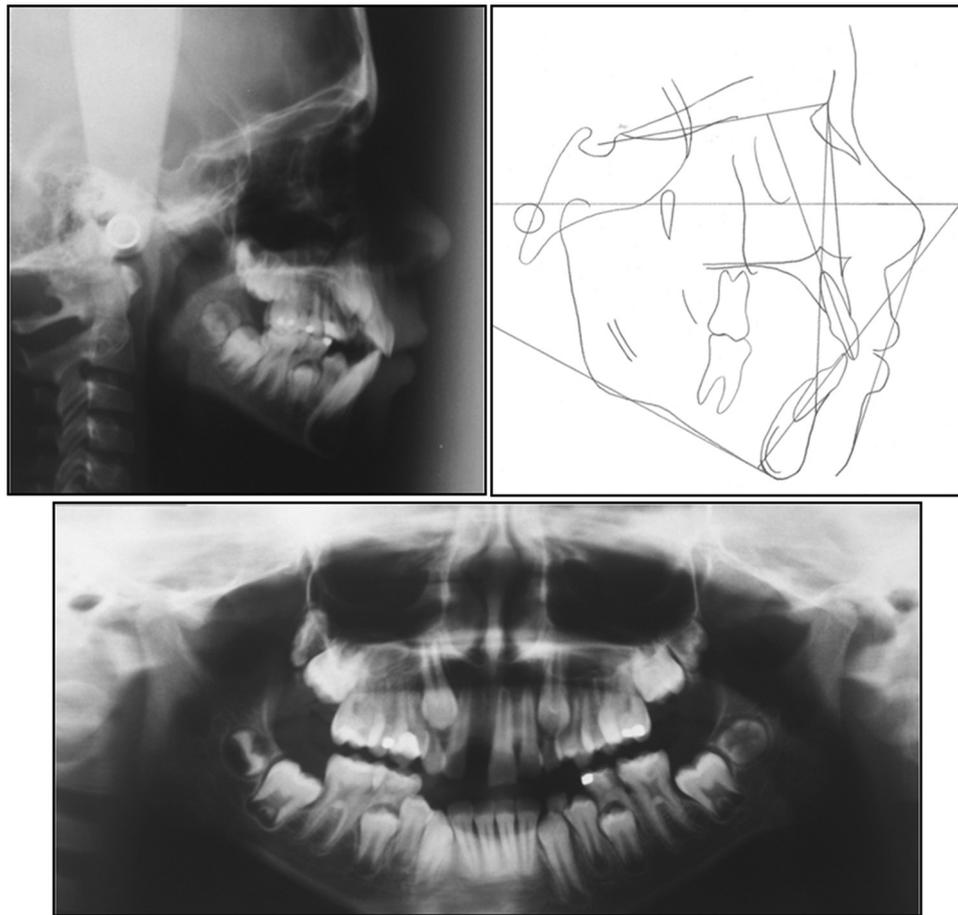


Fig 3. Initial radiographs and cephalometric tracing.

Table. Cephalometric measurements

	<i>Pretreatment</i>	<i>Posttreatment</i>	<i>Norm</i>
Maxilla to cranial base			
SNA (°)	81.5	79.8	82.0
Mandible to cranial base			
SNB (°)	76.5	75.5	80.9
SN-MP (°)	42.0	36.0	32.9
FMA (MP-FH) (°)	34.8	28.1	25.4
Maxillomandibular			
ANB (°)	5.0	4.3	1.6
Maxillary dentition			
U1-NA (mm)	3.0	2.4	4.3
U1-SN (°)	101.6	101.0	102.3
Mandibular dentition			
L1-NP (mm)	5.3	5.5	4.0
L1-MP (°)	94.5	99.8	95.0
Soft tissues			
Lower lip to E-plane (mm)	1.8	-0.5	-2.0
Upper lip to E-plane (mm)	1.4	-2.6	-2.9

transplant the extracted mandibular premolar, the appropriate space in the receiving site was obtained quickly before the apical foramen was closed.

The treatment began with the extraction of the maxillary first premolars and the installation of a hyrax device for crossbite correction and to obtain space for transplantation. The device was removed 3 months later when standard edgewise slot 0.022-in brackets were placed. Thus, the space was opened with a nickel-titanium coil spring for the transplantation of the mandibular right second premolar to the space of the maxillary right central incisor.

The surgical procedure was performed as shown in [Figure 4](#) according to the protocol determined by Slagsvold and Bjerck.¹⁰ Because the maxillary right central incisor had been lost almost 3 years previously, the bone edge was reabsorbed and quite constricted in buccolingual thickness ([Fig 4, A](#)). Surgery with drills and saline solution irrigation was performed to yield 1 socket to receive the self-transplanted premolar ([Fig 4, B-D](#)). After that, the donor tooth was extracted carefully, so as to not damage the structures of the periodontal ligament ([Fig 4, E](#)). However, because of poor bone levels, the alveolus had no cortical bone

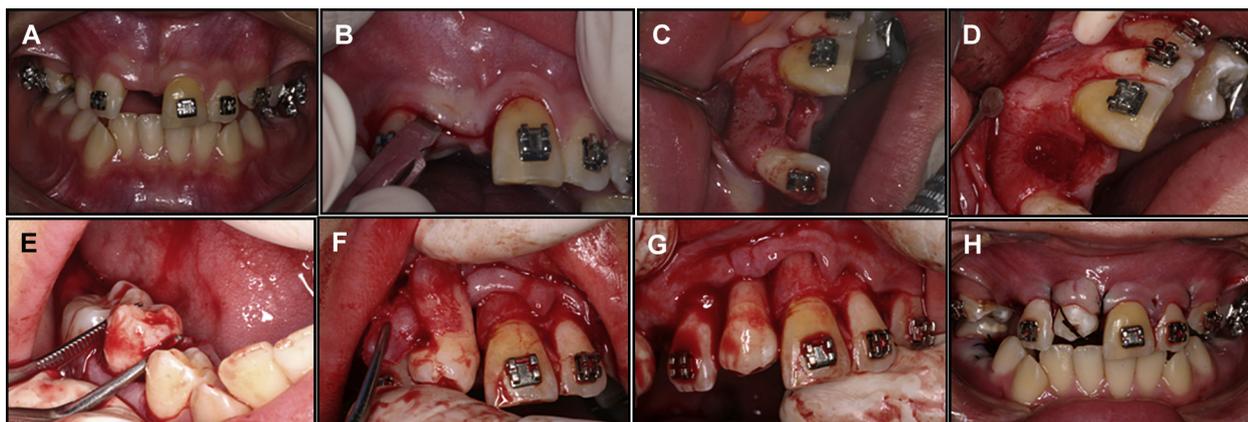


Fig 4. Surgical autotransplantation: **A**, receiver site ready to receive the transplanted tooth; **B-D**, surgical procedure for the preparation of the bone socket; **E**, removal of the dental germ of its original site; **F-H**, placement of the tooth germ into the receptor and stabilization.

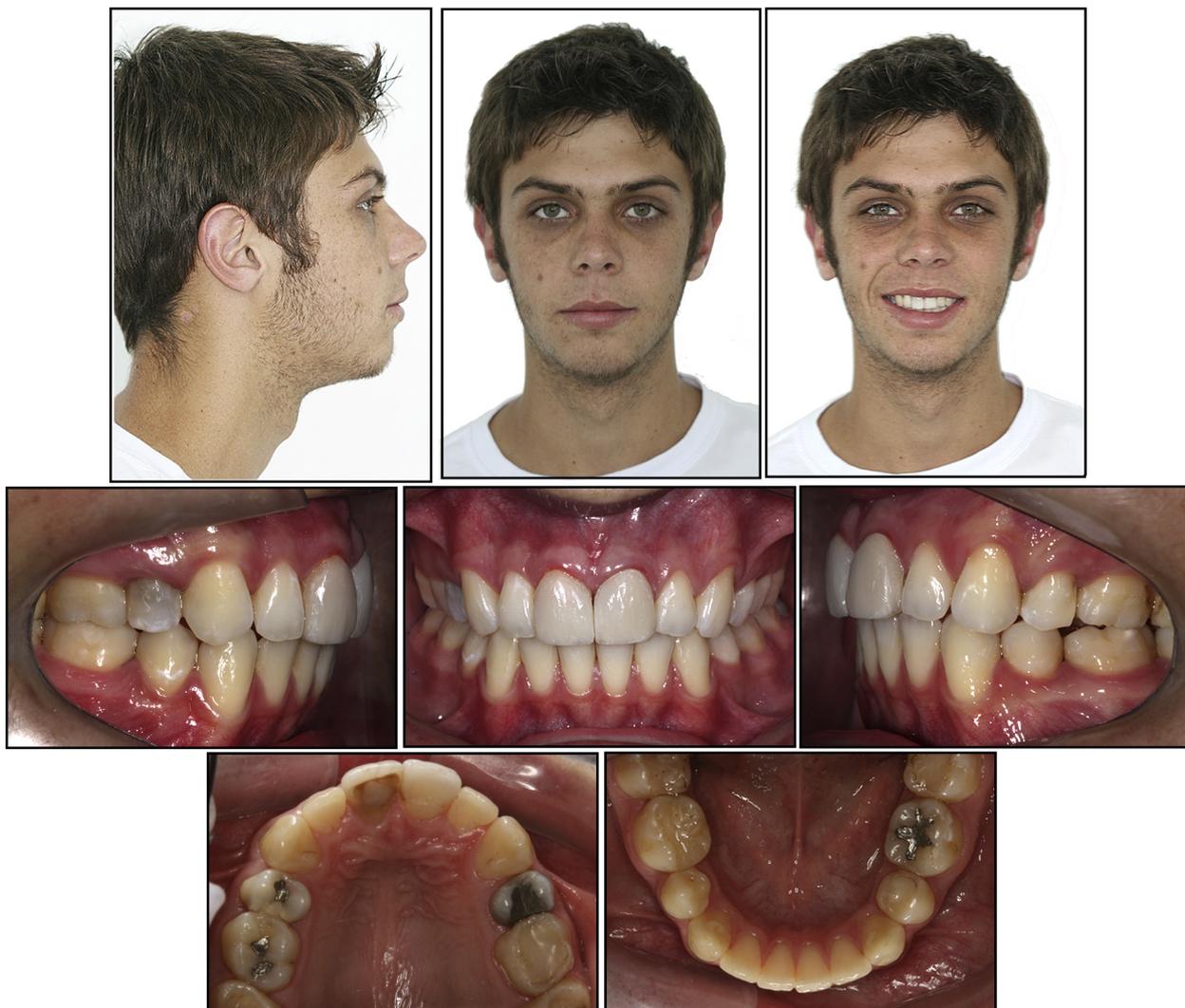


Fig 5. Final extraoral and intraoral photographs.

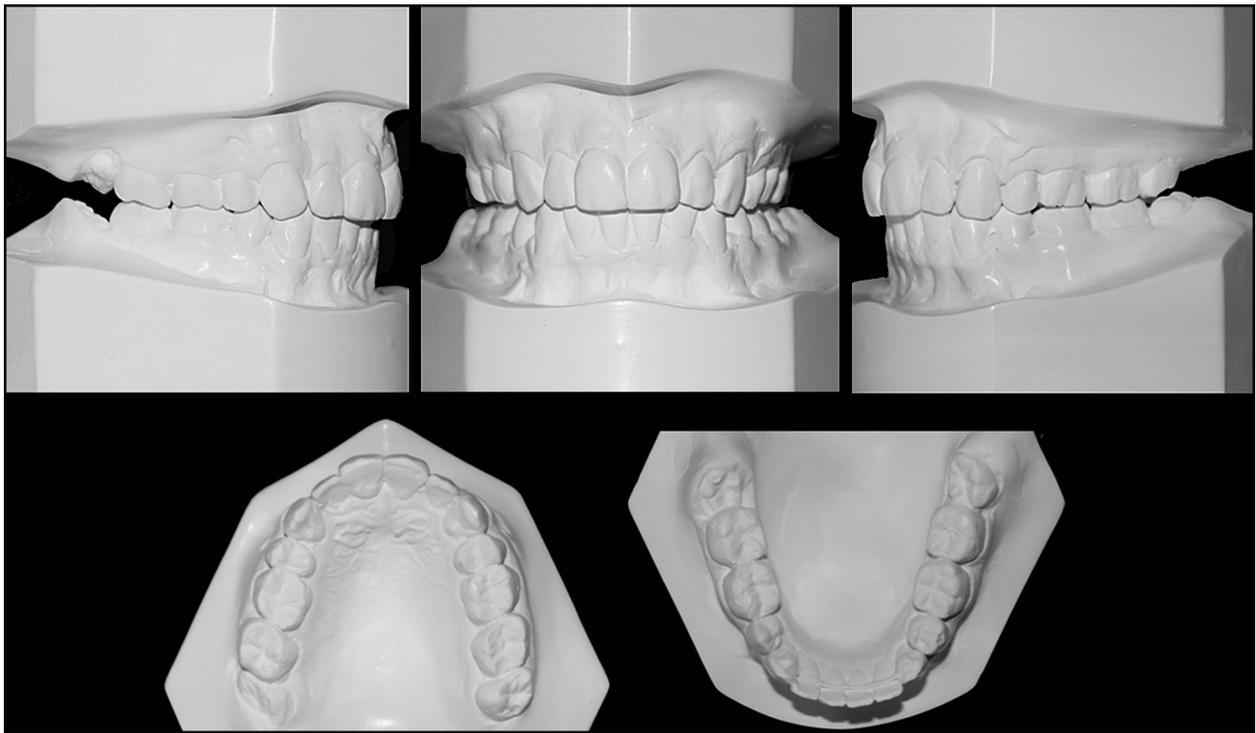


Fig 6. Final dental casts.

(Fig 4, F). After placing the tooth germ gently in this new bone in infra-occlusion, the patient was instructed to be careful that the transplant did not receive any pressure to prevent injury to the periodontium. The gingiva covering the element was stabilized only with a suture to hold it in position (Fig 4, G and H). A lingual arch was placed, and the left mandibular second premolar was extracted.

TREATMENT RESULTS

After 3 years 8 months, Class I molar and canine relationships were achieved, the maxillary and mandibular midlines were coincident, the crossbite was corrected, the extraction spaces were closed, and proper alignment and leveling were obtained (Figs 5-7). The profile was acceptable, despite the Class II skeletal pattern; the patient had a pleasant smile and a good incisor relationship. It was requested that the patient undergo extraction of the third molars.

Figure 8 shows radiographs before the autotransplantation to 9 years after surgery. A computed tomography scan (Fig 9) suggested that cortical bone had been formed by the deposition of bone on the root of the transplanted tooth. This new bone formation was possible only because of the preservation of the cementum and the periodontal ligament of the transplanted tooth.

DISCUSSION

The treatment of choice for this patient was autotransplantation. Earlier trauma in the incisor region contraindicated large movements of the anterior teeth because resorption was a risk. One advantage of autotransplantation is that even if the transplanted tooth is lost in the future from resorption, the presence of the transplanted tooth while the patient is growing helps to maintain bone in the area and allows vertical bone growth. This characteristic of the autotransplant is extremely relevant in this procedure. Maintaining bone should be considered, especially when the patient loses a central incisor before entering the growth spurt. The maintenance of bone in the transplantation area during this stage of life will facilitate the replacement with a dental implant, if it is needed.⁶

In Scandinavian countries, autotransplantation of premolars to replace missing incisors is a widespread method that has been used for over 40 years.¹¹ However, there is no description of this procedure with the same success rates in other countries because of the difficulty of implementing the technique. It is known that for the procedure to be successful, it is essential to ensure that the periodontium is not injured.⁶

Some authors reported that for patients in whom tooth loss has occurred too early, there can be resorption of the alveolar bone crest, with insufficient bone volume

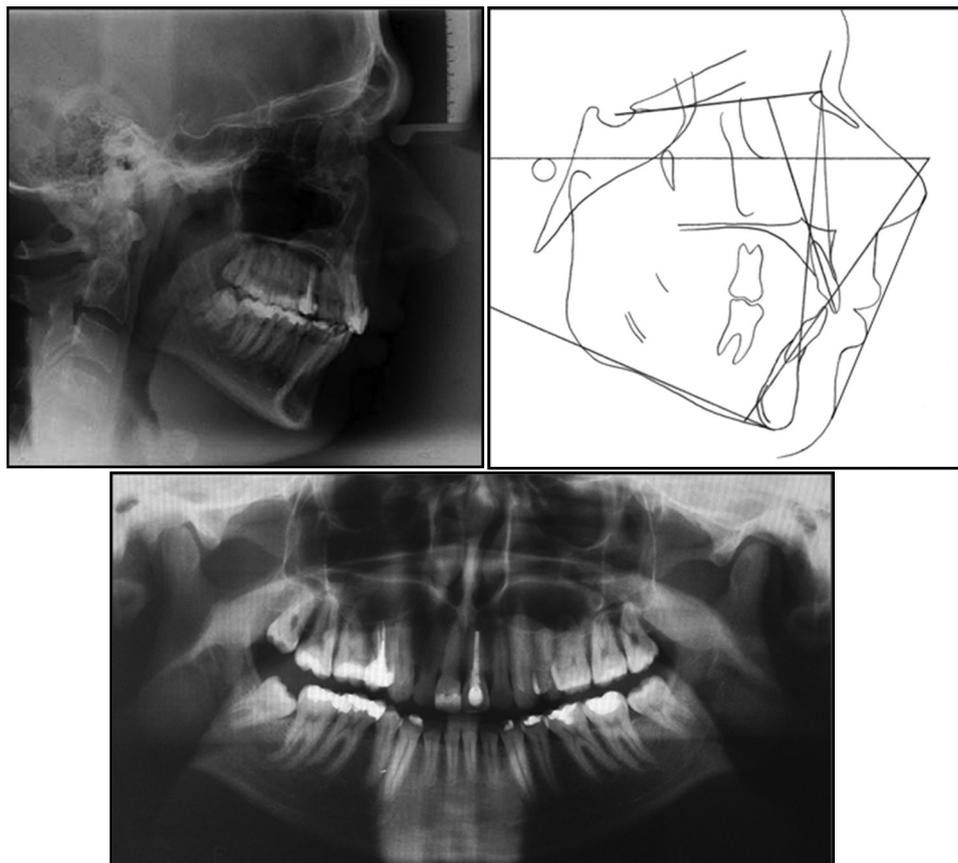


Fig 7. Final radiographs and cephalometric tracing.

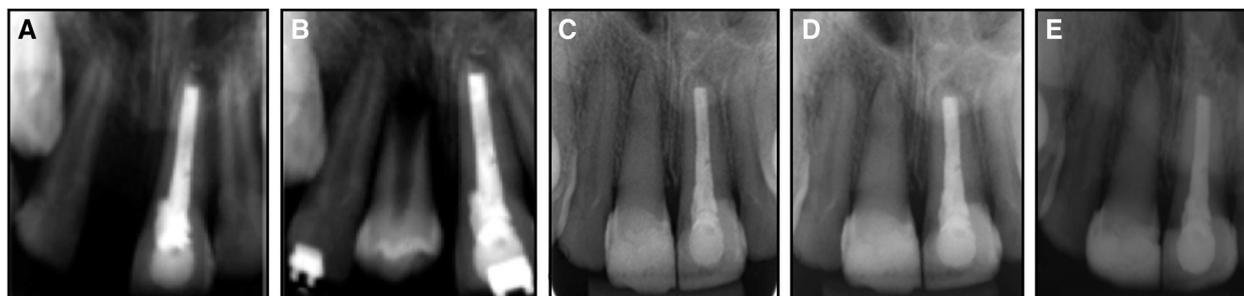


Fig 8. Periapical radiographs from pretreatment to 9 years posttreatment: **A**, initial radiography; **B**, immediately after autotransplantation surgery; **C**, 1-year follow-up (beginning of orthodontic treatment); **D**, 5-year follow-up (orthodontic treatment completion); **E**, 9-year follow-up.

to accommodate vestibule-palatal transplantation, as described here.¹² For these patients, the authors suggested bone grafts before transplantation surgery. This protocol was not adopted because the time required to wait for healing of the graft would compromise the quality of the transplant since the root of the transplanted tooth would be in an advanced stage of development.

The ideal stage for transplantation (3/4-4/4 formed root with open apex) and the preservation of the periodontal structures (ligament and cementum) are fundamental to the success of this therapy.^{4,13}

In our patient, the tooth was transplanted with three-quarters of the root formed. The advantage of performing the transplant in this situation is that the element will provide satisfactory implementation, in addition to



Fig 9. Tomography at the 7-year follow-up. The longitudinal section of the maxillary right central incisor region shows that vestibular cortical bone formed on the root of the transplanted tooth after orthodontic treatment.

maintaining nutrition and continuing the formation process until closure of the root apex.

The preservation of the periodontal structures hinders the formation of ankylosed areas around the transplanted root. In addition, the periodontal ligament provides undifferentiated progenitor cells that are capable of differentiating into fibroblasts, osteoblasts, and cementoblasts. The differentiated osteoblasts can generate bone around the transplants, filling the gap between the walls of the alveolus and the transplant, and causing osteogenesis.^{14,15} In this patient, there was bone formation in the vestibular region that could be easily observed in the computed tomography scan.

Because of the great difficulty in accessing computed tomography scanners and the high cost of screening when this patient started treatment, no initial tomographic documentation was made for comparison. Nevertheless, during the surgery, it was possible to observe the thinness of the bone in this region and the absence of sufficient bone in the socket created to receive the transplant.

CONCLUSIONS

A 10-year-old boy had lost his maxillary right central incisor from dental trauma when he was 8. Orthodontic treatment was performed, and the lost tooth was replaced with autotransplantation of the mandibular right second premolar. The proposed treatment successfully achieved all desired objectives to the satisfaction of the patient and his parents.

Tomography at the 7-year follow-up showed good periodontal support on the transplanted buccal root, and radiography at the 9-year follow-up showed good periodontal support.

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