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Case Report

ORTHODONTIC AND SURGICAL DISINCLUSION OF AN IMPACTED ANKYLOSED CUSPID: A CASE REPORT

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ABSTRACT

Dental ankylosis is defined as the alveolar bone's fusion with dentin or cement. Maxillary cuspids are important teeth both in terms of aesthetics and function. A cuspid's eruptive failure probability is estimated to be 1-3%. In most cases, the crown surgical exposure of the impacted cuspid is carried out after the orthodontic treatment start, when the dental alignment is obtained, as the canine space is obtained. Usually, immediately after surgery, the orthodontist begins to direct the element towards its natural location. However, these mechanics are not always successful. In this case, another option is possible. Here we report a case of canine autotransplant performed to bring an ankylosed impacted upper cuspid into the dental arch.

KEYWORDS: *cuspid, impacted, tooth, movement, ankylosis*

INTRODUCTION

Dental ankylosis is defined as the alveolar bone's fusion with dentin or cement (1). An ankylosed tooth does not respond to orthodontic forces; therefore, surgical procedures may be indicated to facilitate its movement. In order to bring an ankylosed impacted tooth into the arch, a surgical exposure with luxation and orthodontic movement or an autotransplant can be performed.

The type of surgery to expose the impacted tooth, the necessary orthodontic mechanics, the timing of orthodontic treatment, potential treatment problems and prognosis depend on the type of tooth, its position, upper or lower arch location and the patient's age.

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Diagnosis and location of dental inclusion are based on clinical and radiographic examination. Radiographic examinations (OPT, teleradiography of the skull, occlusal and intraoral radiographs according to the Clark technique, CT) confirm the diagnosis of dental inclusion and provide information regarding the position of the ectopic element, its relationship with adjacent teeth and any resorption, allowing to select the most appropriate treatment method (2, 3). Therefore, cone beam CT is the diagnostic method of choice. Although the image definition is similar to traditional CT, exposure to ionizing radiation is significantly reduced; moreover, it allows perfect three-dimensional reconstruction of the maxilla and detailed position of dental elements.

Maxillary cuspids are important teeth both in terms of aesthetics and function. A cuspid's eruptive failure probability is estimated to be 1-3% (4, 5). Impacted maxillary cuspid ankylosis can make obtaining optimal orthodontic treatment aesthetic and function more difficult. About one-third of impacted maxillary cuspids are positioned vestibularly, while the remaining two-thirds are located palatally (6). Canine inclusion causes are multifactorial (local and genetic) and may be correlated with other dental anomalies. Local causative factors are dento-basal discrepancies, which reduce eruptive space, prolonged tooth retention or early deciduous canine loss, abnormal dental bud position, cleft, root dilaceration, or idiopathic conditions (7, 8). As for other impacted teeth, the treatment's prognosis depends on the dental position in the alveolar process and its relationship with adjacent teeth.

The impacted cuspid's disinclusion approach is multidisciplinary and often involves an orthodontist, oral surgeon, pedodontist, and periodontist (9). In most cases, the crown exposure surgery of the impacted cuspid is carried out after the orthodontic treatment start, when the dental alignment is obtained, as the canine space. Usually, immediately after surgery, the orthodontist begins to direct the element towards its natural location. However, these mechanics are not always successful: the tooth may not respond to the applied orthodontic forces, a clear sign of dental ankylosis.

MATERIALS AND METHODS

A 15-year-old male patient presented for our observation complaining about no upper canine eruption. The intraoral clinical examination revealed an Angle class I malocclusion due to modest dentobasal discrepancy (DBD) (diastemas in the upper arch and crowding in the lower arch) and permanence of upper deciduous canines. The recent and remote medical history was negative for systemic pathologies or pathologies of dental interest. The orthopantomography confirmed what was evident on intraoral examination: the permanence of deciduous cuspids and disodontiasis with the inclusion of substitutes (Fig. 1).

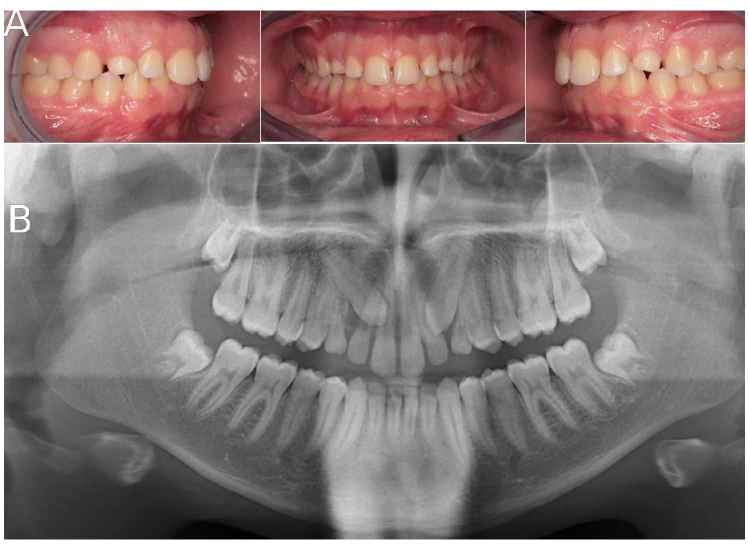

Fig. 1. ***A)*** *Angle I class with mixed dentition in the upper arch, with upper deciduous cuspids' permanence. Modest DBD with diastemas in the upper arch and crowding in the lower arch;* ***B)*** *The OPT shows the permanence of deciduous canines and disodontiasis with the inclusion of substitutes.*

The cone beam CT showed the presence of both upper canines in palatal inclusion: 1.3 in bone inclusion and 2.3 in osteo-mucosal inclusion. The relationships with the contiguous teeth roots were favourable: the roots of both impacted elements had no relationship with the roots of the premolars, and the crowns were palatally localized to those of the incisors. In addition, 1.3 had a more pronounced mesial inclination than 2.3. There was no evidence of any root resorption of proximal teeth (Fig. 2). The case required orthodontic recovery of both maxillary cuspids.

In the first instance, the surgical act of exposing definitive cuspids was carried out: after loco-regional anaesthesia (mepivacaine with adrenaline 1: 200,000), a full-thickness palatine flap was designed that did not affect papillae and nasopalatine nerve; subsequently the 1.3 crowns was exposed, removing the thin bone case that covered it; both canines were delicately dislocated and thin osteotomies, 3 mm deep, were performed by piezoelectric surgery in order to facilitate orthodontic traction (Fig. 3); subsequently two orthodontic buttons with a woven metal ligature were applied, in order to allow orthodontic traction forces' application to the tooth, and the flap was sutured. However, deciduous canines have not yet been extracted to maintain space.

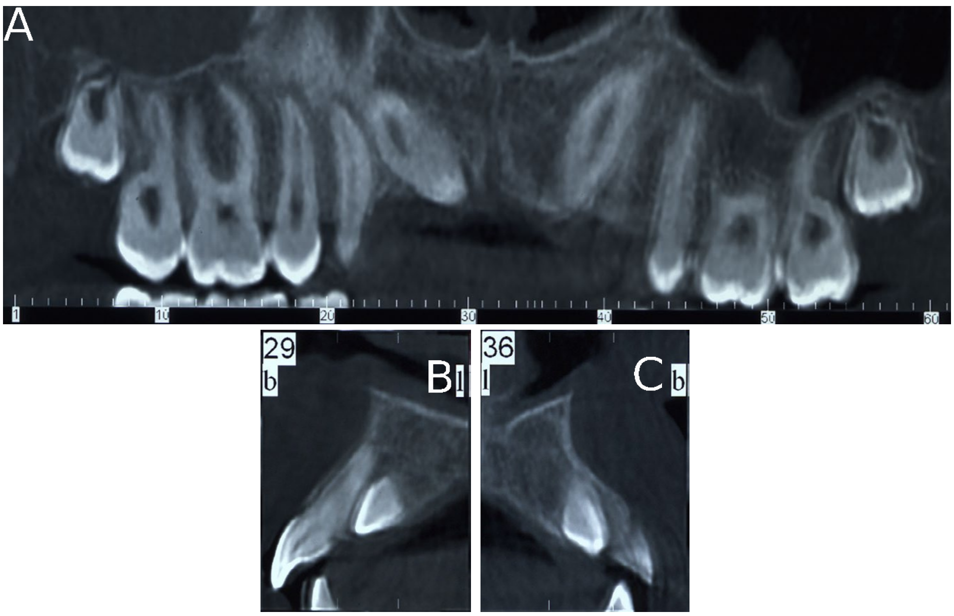

Fig. 2. ***A)*** *CBCT section showing the position of the upper cuspids;* ***B)*** *CBCT section showing the presence of a thin bone case on 1.3;* ***C)*** *CBCT section showing the osteo-mucosal inclusion of 2.3.*

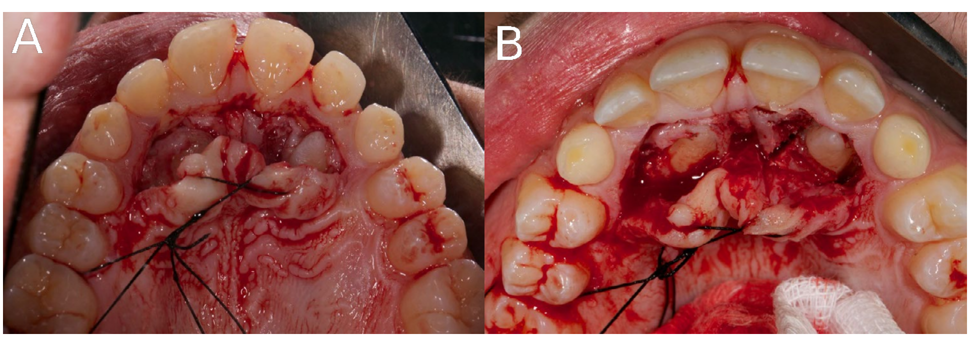

Fig. 3. ***A)*** *1.3 bone inclusion and 2.3 osteo-mucosal inclusion;* ***B)*** *3 mm deep osteotomies using piezoelectric surgery to promote orthodontic disinclusion.*

At 3 days after the surgery, a sixth to sixth upper arch bonding was performed, except for the two deciduous cuspids, and a passivated steel orthodontic wire with a round section (diameter 0.020 inches) was placed; it was used as anchorage for the canines' traction. Immediately after bonding, the deciduous cuspids were extracted to proceed with gentle traction of the permanent canines in the vestibule-distal direction using elastomeric threads tied to the archwire.

About 10 months after the start of therapy, 2.3 erupted palatally, while 1.3 did not show to respond to orthodontic forces on intraoral x-rays. Therefore, suspecting that a scar consisting purely of fibrous tissue was opposing to non-inclusive forces, the fibro-mucosa was removed by an electrosurgical device, exposing the crown of the tooth, which was again delicately dislocated. A few weeks after this second surgery, the healing was complete, with a restitutio ad integrum of the soft palatine tissues; in the meantime, 1.3 has always been pulled with elastic threads. After a few months, noticeable results were still visible, but a modest intrusion of the anchorage teeth was highlighted. It was therefore decided to perform a new cone beam CT of the upper arch (Fig. 4).

Upon examination of this further radiographic investigation, the situation remained substantially unchanged as regards the position of 1.3 compared to the previous CT investigation. Therefore it was decided to subject the patient to a surgical repositioning of 1.3 in order to restore the occlusion without the need to perform extraction and implant-prosthetic rehabilitation. After loco-regional anesthesia (mepivacaine with adrenaline 1: 200,000) a full thickness palatine and buccal envelope flap was drawn with papillae involvement; lifting the flap and comparing the surgical site with the first uncovering operation, it was evident that the element had not moved from its original position, confirming the hypothesis of ankylosis. Bone incisions were made using piezoelectric equipment on the impacted canine's alveolus in order to displace the tooth in its final position. The receiving site was created by removing a small amount of bone, surgically intervening only on the crestal and palatal surface, leaving the vestibular one unaltered, not to give rise to subsequent bone dehiscences with consequent damage to the periodontium. Then the tooth was dislocated and placed in the receiving site. The obtained position was not the desired one, since the tooth was extruded more than necessary and with a strong vestibular inclination. Two further vertical osteotomies were then performed in the vestibular alveolar process to facilitate an orthodontic movement of the tooth by exploiting the consequent Rapid Acceleratory Phenomenon (RAP) (10, 11); the flaps were sutured and the tooth was stabilized to the archwire using a fluid composite (Fig. 5).

Two weeks after the repositioning surgery, the tooth was cleaned from composite and bonded with an orthodontic bracket; subsequently it was engaged in a 0.016-inch steel archwire and distally pulled by an elastomeric chain with heavy orthodontic force to exploit the RAP.

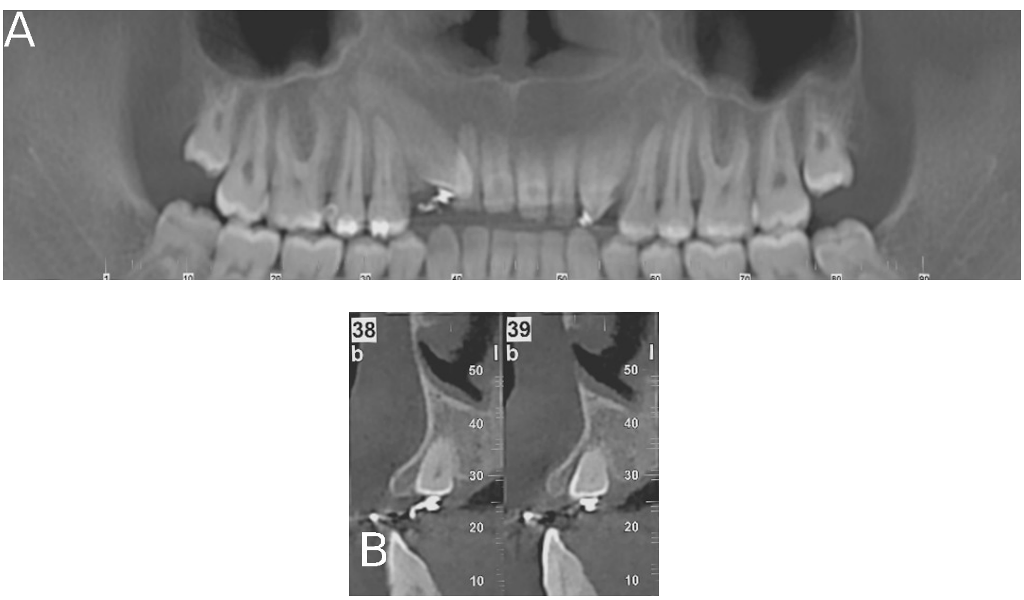

Fig. 4. ***A)*** *CBCT section showing the position of the upper cuspids;* ***B)*** *CBCT section showing the substantially unchanged position of 1.3.*

Six weeks after the last surgery, the tooth was completely in contact with the premolar, a sign that the orthodontic movement had taken place correctly (Fig. 6). It was thus possible to switch to a .019x.025 inches steel archwire to provide a correct radiculo-buccal torque at the root of 1.3.

During all post-surgery visits, the mobility and vitality of the surgically repositioned tooth was constantly monitored, which showed compatible values with the orthodontic and surgical actions performed on it. Mesially, a gingival recession caused by the rapidity of displacement occured. However, periodontal probing revealed the presence of an epithelial attachment with a 1.5 mm probing. At 16 weeks after surgery, the cuspid responded positively to the vitality tests.

At the end of the orthodontic-surgical treatment, the endodontic treatment of the upper canines was necessary due to the appearance of internal resorptions (Fig 7).

However, the effectiveness of the treatment performed will have to be verified over time, since the literature reports evidence of endodontic and periodontal problems following arch recovery treatments of autotransplanted ankylosed teeth (12).

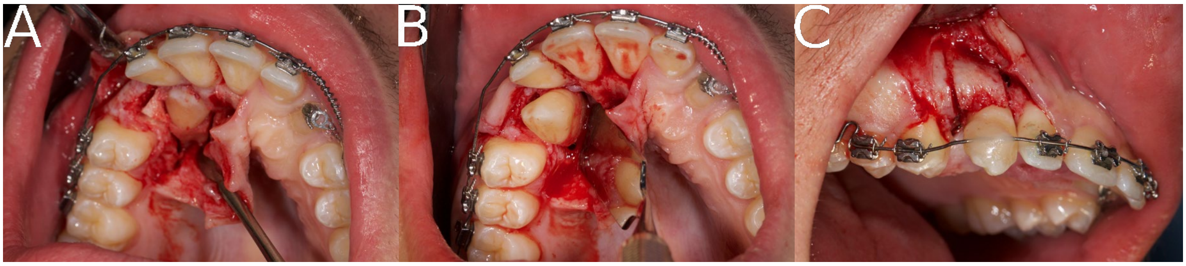

Fig. 5. ***A)*** *Exposure of ankylosed 1.3 and osteotomies;* ***B)*** *Dislocation of 1.3;* ***C)*** *1.3 placed in its site and peri-radicular corticotomies.*

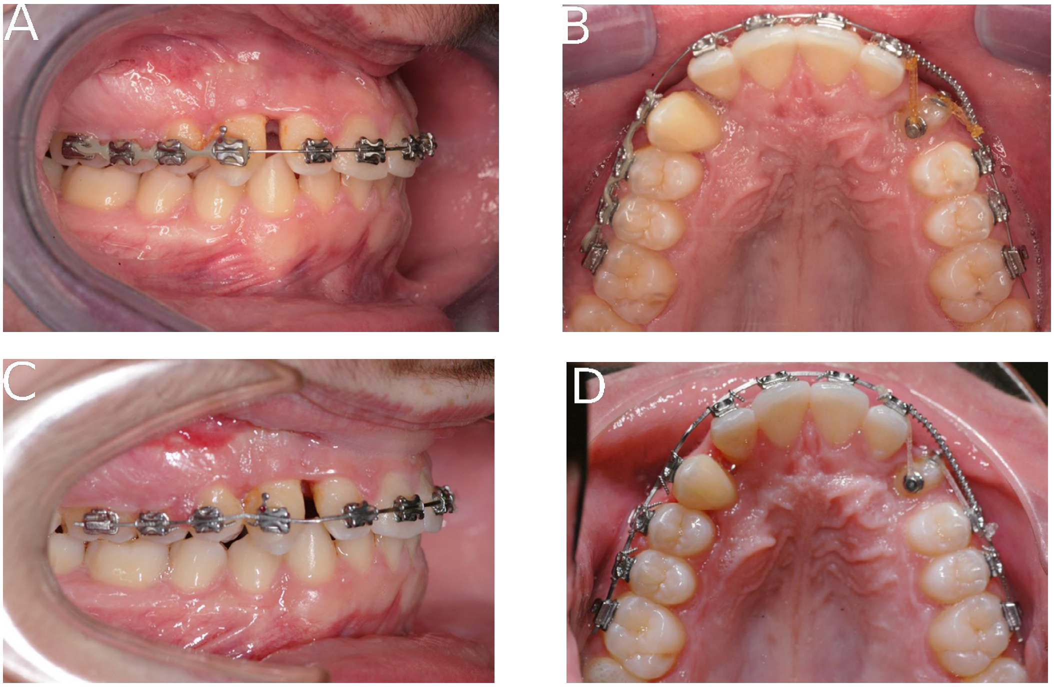

Fig. 6. ***A-B)*** *.016 inches round stainless-steel archwire and elastomeric chain;* ***C-D)*** *.019x.025 stainless-steel archwire with radiculo-buccal torque on the right cuspid.*

DISCUSSION

Maxillary cuspids are the teeth that are most frequently impacted (excluding third molars). According to Dewel (13), canines have the longest development period, as well as the longest and most tortuous path from the point of formation to their final destination in the arch. Given their importance for function and aesthetics, when impacted it is important that they are brought into their correct position. However, it is not a rare occurrence that during the traction phases they go into ankylosis, or that they are already ankylosed before treatment, so it is necessary to find a clinical solution for their restoration in the arch.

The traditional treatment for an ankylosed impacted cuspid in an adult, if this damages the proximal teeth or prevents implant rehabilitation, involves the surgical removal of the element and rehabilitation by means of an implant-prosthesis. However, this treatment can produce a large bone defect in the alveolus that often requires bone augmentation before implant placement.

In growing patients, one option is osteogenetic distraction, a procedure useful for producing new soft and hard tissues by moving a bone segment. In agreement with Koford et al. (14) the tooth-bone segment is displaced by the distractor following appropriate osteotomies. The main limitation of this method is that it allows bone-tooth segments to be moved only in one direction, therefore it is not applicable to palatally ankylosed cuspids or canines with inclinations such as to prevent correct aesthetic and functional repositioning.

Therefore, it is more desirable to attempt orthodontic-surgical recovery of the ankylosed cuspid by direct repositioning, creating a receiving site and dislocating the tooth by moving it to the desired position. It is also useful to avoid the complete extraction of the tooth by removing it from the oral cavity, because this could lead to damage to the periodontal ligament with the consequent risk of a subsequent new ankylosis of the canine.

Having analyzed the problems resulting from dental autotransplants, we came to the conclusion that the repositioning

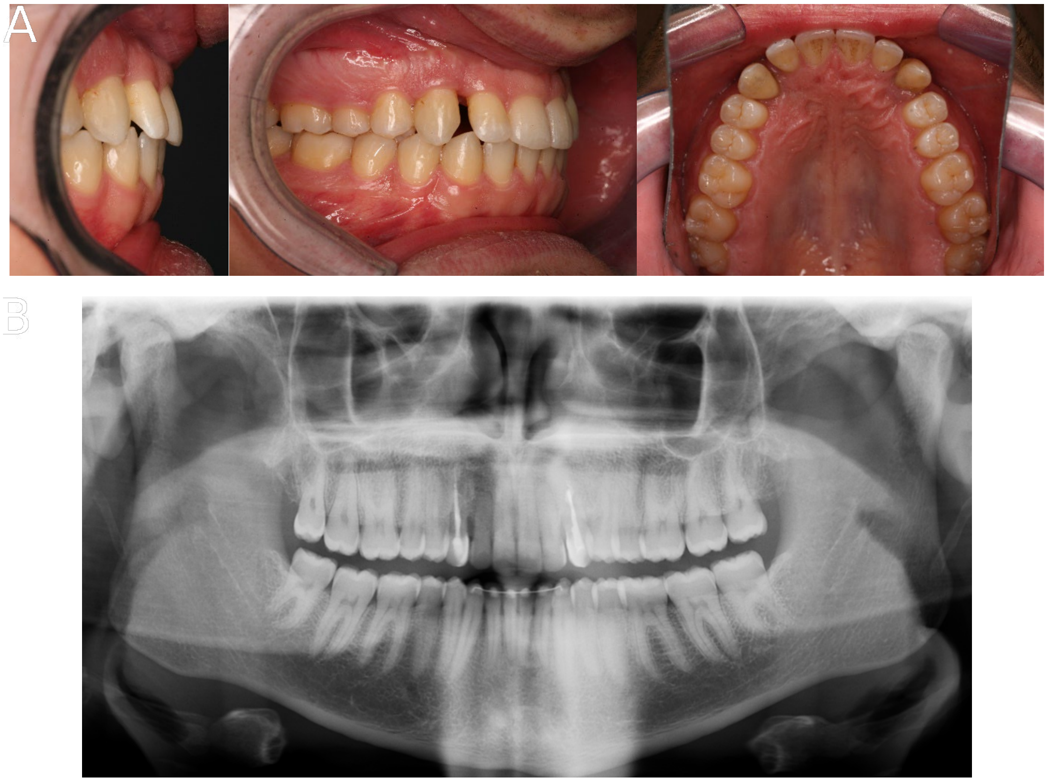

Fig. 7. ***A)*** *The case after debonding with the complete repositioning of the canines;* ***B)*** *The end-of-treatment orthopantomography.*

of our patient's cuspid in a location that is not entirely appropriate could result in aesthetic and functional damage since it would not have been possible to apply orthodontic forces at a later time, despite not had been fully extracted. However, considering the current innovations on piezolectric surgery applied to orthodontics, we have tried to overcome the problem of ankylosis by allowing a tooth movement favored by the RAP (10, 11). According to Frost's theory, after a surgical insult, the bone tissue reacts with a rapid, transient and localized osteopenia in which there is no loss of bone volume, but loss of bone density. This phenomenon is referred to as RAP which increases the speed of the orthodontic movement from 2 to 10 times; it begins 2-3 days after surgery and peaks at 1-2 months (15). For these reasons, two vertical osteotomies were performed on the vestibular side of the alveolar bone of the receiving site of the ankylosed cuspid.

CONCLUSION

The orthodontic treatment of tooth repositioning by means of autotransplantation with the aid of piezoelectric surgery is applicable to ankylosed impacted canines in growing patients, since it allows, in addition to a rapid restoration of functionality and aesthetics of the cuspid, also a subsequent orthodontic correction of its position.

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