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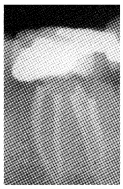

CASE REPORT

Treatment of an avulsed maxillary permanent central incisor by autotransplantation of a primary canine tooth

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Abstract

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Aim To present a case in which an avulsed permanent maxillary central incisor was replaced by autotransplantation of a primary canine tooth.

Summary The present case describes transplantation of a primary canine tooth into the space left by an avulsed permanent maxillary central incisor after a delay of several days. After root canal treatment, the primary canine tooth was extracted and placed into the prepared socket. To provide better adaptation of the donor tooth, the recipient alveolar site was remodeled using surgical burs. Semi-rigid splinting was maintained for 15 days. The crown of the primary canine was reshaped with composite resin and with an interim prosthesis, preventing movement of the lateral incisor tooth into the space of the transplanted canine. After 24-month follow-up the autotransplanted primary canine showed ankylosis but the tooth was in an acceptable state. The use of permanent tooth autotransplantation has been well documented. However a literature search revealed only one case report on the autotransplantation of primary teeth.

Key learning points

- Long term results of primary tooth autotransplantation are scarce but the procedure in this case report could be considered as a temporary space maintainer for the treatment of a patient with a lost permanent incisor under 10 years of age.
- Success of primary tooth autotransplantation may be affected by several factors, such as case selection, extra oral time, surgical and endodontic procedures.

Keywords: avulsion, primary canine, transplantation.

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Introduction

The incidence of trauma to permanent teeth has been reported between 7% and 19% (Jarvinen 1979, Kaba & Marechaux 1989, Perez *et al.* 1991, Zerman & Cavalleri 1993, Josefsson & Karlander 1994). Avulsions account for 7.6% of all permanent tooth traumas (Zerman & Cavalleri 1993). Maxillary central incisors are the most commonly involved teeth (Jarvinen 1979, Kaba & Marechaux 1989, Perez *et al.* 1991, Zerman & Cavalleri 1993, Josefsson & Karlander 1994, Saroglu & Sonmez 2002) and injury is usually seen in children between 7 and 9 years of age when central incisors erupt and the periodontal ligament provides only minimal resistance to an extrusive force (Harlamb & Messer 1997).

Ideally, the treatment of an avulsed tooth is replantation of the tooth into its own socket within 20–30 min of injury or keeping the tooth in an appropriate storage medium until the patient can be treated by a dentist (Andreasen 1981a, Blomlof 1981, Andreasen *et al.* 1995). If the tooth is not replanted, the alternative choices are orthodontic treatment to either close the space or preserve it for future restoration with a fixed or removable prosthesis or a dental implant. The type of restoration depends on factors including the patient's age, amount of alveolar bone present, and integrity of the adjacent teeth.

Another option is the transplantation of a tooth into the space left by the avulsed tooth (Khongkhunthian *et al.* 2002). The use of premolar autotransplantation in cases of agenesis or traumatic loss of maxillary incisor has been well documented (Bowden & Patel 1990, Kristerson & Lagerstrom 1991). Transplantation of premolars with half to three quarter root development is recommended because this procedure provides a good chance of pulp survival, limited risk of root resorption and ensures sufficient final root length (Kristerson 1985). However, transplantation of tooth germs in dogs at an early stage of development where crown formation was complete and early root formation had commenced showed no further root development and later resorption of the teeth (Monsour & Adkins 1983). For these reasons, in children less than 10 years of age, the transplantation of a primary tooth to replace a lost incisor could be a treatment option (Pohl *et al.* 2001).

The aim of this case report is to present the delayed autotransplantation of a primary canine tooth into the space left by an avulsed permanent maxillary central incisor.

Case report

An 8-year-old girl was referred to a dental clinic after trauma caused by a bicycle accident. At the clinic, emergency treatment was only focused on soft tissue wounds. After ten days, the patient was referred to the paediatric dentistry clinic. The patient's medical history was unremarkable, and she was already immunized against tetanus.

Extra-oral examination revealed no soft tissue injury, probably because of the time elapsed since injury. Intraoral examination revealed avulsion of tooth 21 (FDI); tooth 11 was also extruded and had second degree mobility (Andreasen *et al.* 2006) (Fig. 1a). Teeth 12 and 22 were luxated with minor mobility. Furthermore, intraoral examination revealed neither lacerations nor evidence of alveolar bone fracture.

A periapical radiograph showed the complete loss of tooth 21 with a normal socket (Fig. 1b). After the radiographic examination of the root lengths of all primary canine teeth, tooth 63 was selected for transplantation. Following the delivery of local anaesthesia (Ultracain D-S, Istanbul, Turkey) and isolation with rubber dam, root canal treatment was completed at a single visit, root-filling tooth 63 with white MTA (ProRoot, Dentsply Tulsa Dental, OK, USA). The surgical treatment was performed under local anaesthesia at the same session.

Before preparing the recipient socket, tooth 63 was extracted and evaluated for physiologic resorption and PDL condition. An intra-crevicular incision was made before

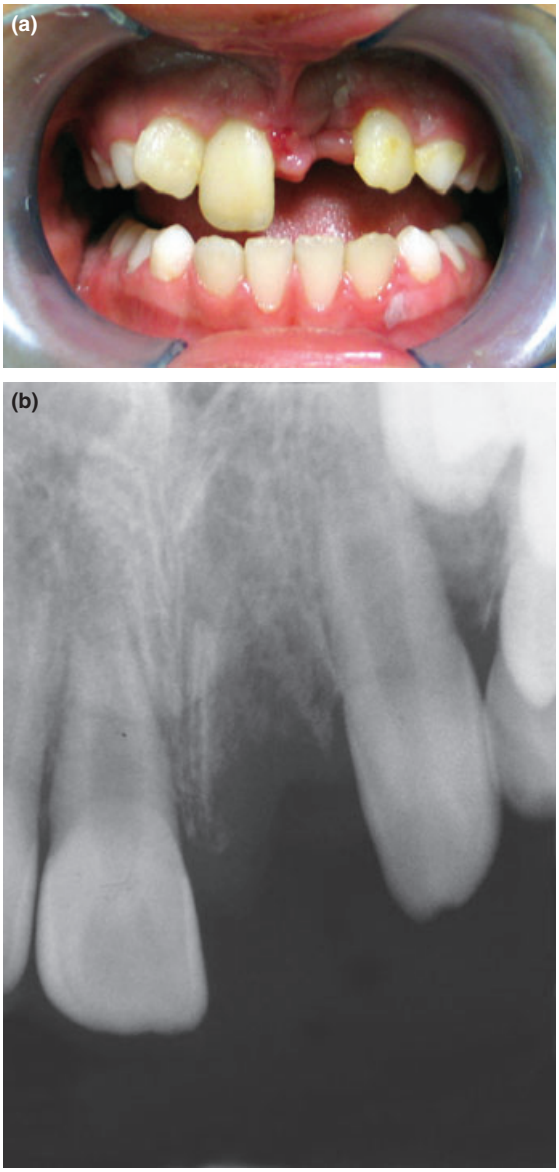

Figure 1 (a) Initial clinical view of the 8-year-old girl with avulsed tooth 21 and extruded tooth 11. (b) Pre-operative radiograph of the maxillary anterior region revealing the empty tooth 11 socket.

luxation to preserve as much PDL on the root as possible and tooth 63 was extracted slowly. While the recipient socket was prepared, tooth 63 was placed back into its orginal socket. After buccal and palatal full thickness mucoperiosteal flaps were raised, the empty tooth 21 socket was reshaped with round burs at low speed under a flow of physiologic saline. The match between the recipient site and the donor tooth was periodically checked with light pressure. When a suitable socket was prepared, tooth 63 was placed into the prepared socket. After suturing the gingiva, close contact of the gingiva to the cervical region of the transplant was achieved. The transplanted tooth was splinted to neighbouring teeth with 0.5 mm diameter nylon monofilament and composite resin (Charisma, Heraeus Kulzer, Wehrheim, Germany) for 15 days (Fig. 2a,b). The patient was prescribed 25 mg/kg tetracycline for 7 days and healing was uneventful. On

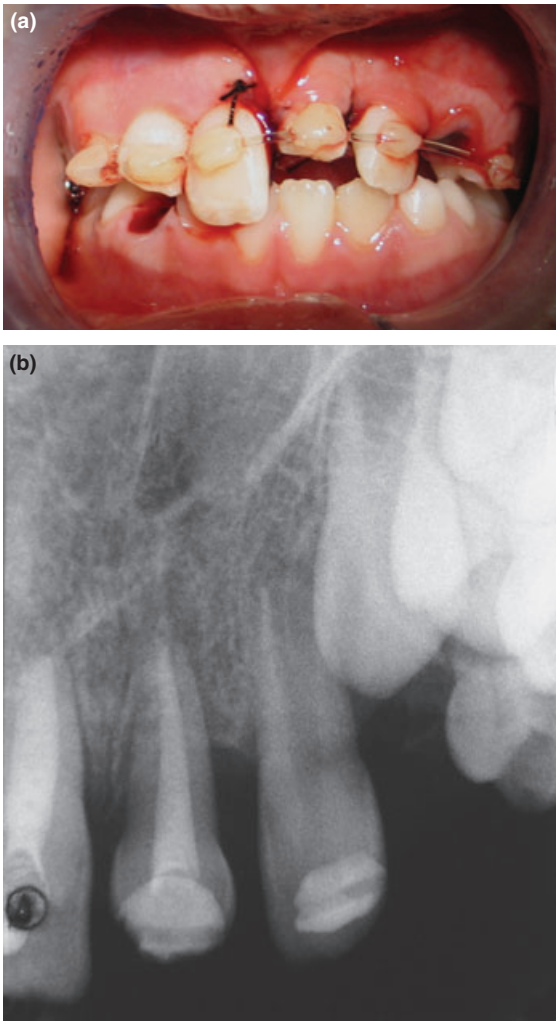

Figure 2 (a) Clinical view after the transplantation of tooth 63 into 21 socket. (b) Radiographic appearance of tooth 63 after root canal treatment and transplantation.

post-operative day two, oral hygiene instruction was given and the patient was prescribed 0.2% chlorhexidine mouthwash for 10 days.

Three weeks after the transplantation, the crown of the primary canine was reshaped with a strip crown and composite resin (Charisma, Heraeus Kulzer, Wehrheim, Germany) (Fig. 3a,b). Movement of tooth 22 into the space of the transplanted canine was prevented with an interim prosthesis. Meanwhile, pulp necrosis was detected in the extruded tooth 11 which had an open apex. The pulp was extirpated and the root canal dressed with nonsetting calcium hydroxide paste (Kalsin, Aktu Tic, İzmir, Turkey). After 3 weeks of calcium hydroxide medication, white MTA (ProRoot, Dentsply, Tulsa Dental, OK, USA) was gently compacted using hand pluggers to produce a barrier at the level of the apex. The remainder of the root-canal was then filled with AH plus (Dentsply De Trey GmbH, Konstanz, Germany) and gutta-percha (SPI Dental Mfg. Inc, Inchon, Korea); finally and all restorations were completed.

After 1 month, neither the transplanted primary canine nor other affected teeth showed pathologic changes on clinical and radiographic examination. However, 5 months after the

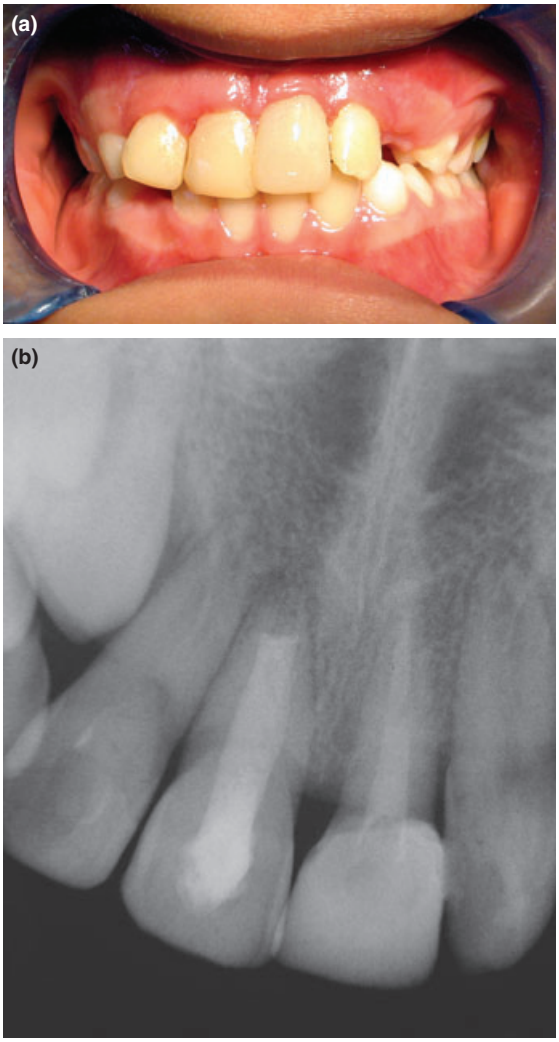

Figure 3 (a) Clinical view three weeks after the transplantation and re-shaping of the crown of tooth 63 with strip crowns and composite resin. (b) Radiograph of the transplanted primary canine after 3 weeks.

autotransplantation, ankylosis of the transplanted tooth 62 and root canal obliteration of luxated teeth 12 and 22 was detected. Careful follow-ups were maintained at 3-month intervals. Twelve months after the traumatic injury, clinical examination revealed the eruption of tooth 23. At this session, the interim prothesis was removed, oral hygine instruction repeated and the patient was encouraged to maintain better plaque control. At the 24-month follow up, the infra-occlusion level of the transplanted primary canine was acceptable (Fig. 4a,b). Both the ankylosed primary tooth and obliterated lateral incisors were kept under review.

Discussion

The loss of maxillary incisors in childhood is problematic; especially up to 10–12 years of age, and predictable treatment methods are difficult (Pohl *et al.* 2001).

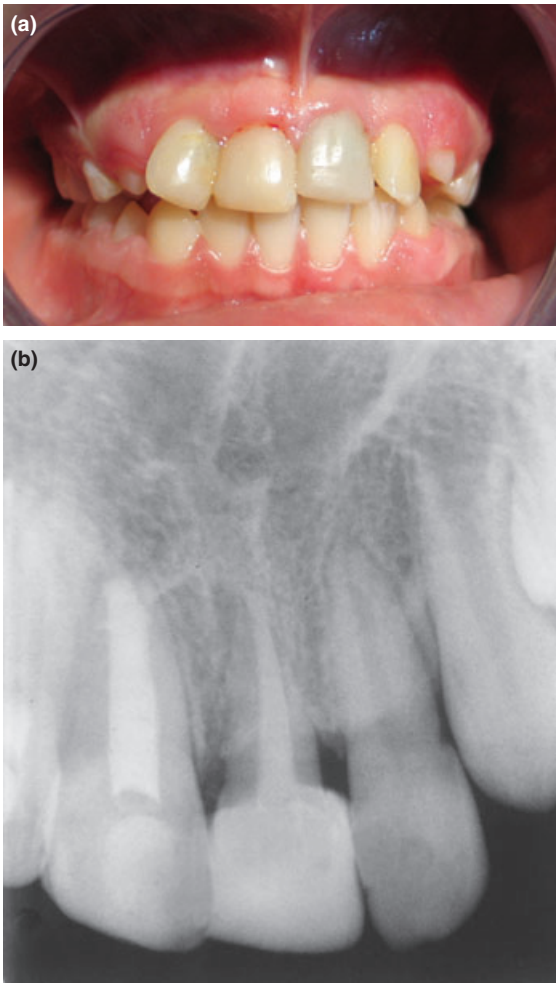

Figure 4 (a) Clinical view of the transplanted primary canine with acceptable infra-occlusion after 24-months. (b) Radiograph of the transplanted primary canine after 24-months, showing some evidence of replacement resorption.

Autotransplantation of teeth to replace missing incisors might be considered if suitable donor teeth are available (Kristerson & Lagerstrom 1991). The transplantation of premolars after traumatic loss of incisors has shown a high success rate when more than 50% of the root is developed. It was reported that transplantation of tooth germs is less successful (Monsour & Adkins 1983). The stage of root development has been thought to be one of the main factors affecting the prognosis of an autotransplanted tooth (Kristerson 1985, Andreasen *et al.* 1990, Kristerson & Lagerstrom 1991). Therefore, loss of anterior teeth in children younger than 10 years old cannot be adequately treated and collapse of the alveolar process and loss of fixed gingiva may result. In this case, all mandibular permanent premolar teeth were in an early stage of development, and it was decided to use the method of Pohl *et al.* (2001). The decision was therefore made to prepare the partially-healed socket and transplant the most suitable primary canine tooth into it.

If autotransplantation of primary teeth is to be carried out, a variety of important issues should be considered. First of all, there are no studies on long term results and whether or not physiological resorption of the donor tooth occurs. Thus, possible treatment outcomes should be discussed with the parents. Also, for long term success, periodontal health and

good oral hygiene are essential. If a primary tooth is to be utilized from the aesthetic zone, it is also wise to check that it has a permanent successor of good morphology and position.

Pulp necrosis will occur when teeth (including primary canines) with a closed apical foramen are transplanted. In order to prevent inflammatory root resorption, root canal treatment is essential (Kristerson 1985). In this case, single-visit root canal treatment with white MTA was undertaken. A single session was decided in an effort to complete surgical and nonsurgical phases at one visit. The root canal treatment was completed before the extraction to shorten the extraoral period and reduce the risk of damage to the periodontal ligament of tooth 63. Although the long term results of white MTA on risk of resorption is not known (White & Bryant 2003), this material was selected due to its biocompatibility (Camilleri *et al.* 2005), good sealing ability (Roy *et al.* 2001, Shipper *et al.* 2004) and the short operating time required to fill the root canal only with MTA (Holland *et al.* 1999).

The use of an 'endodontic implant' by extra-oral insertion of a post through the apex of the transplanted primary canine was not considered in this case, and contrary to Pohl *et al.* (2001), because this procedure would have increased the extraoral period and consequently risked failure. Furthermore, the root length of the transplanted primary canine tooth met the required crown-root ratio. Endodontic implants can be used if physiological root resorption has advanced and the crown-root ratio is insufficient. It is known that as little as 2 mm of autologous root length is enough for successful replantation when the root is elongated with a post inserted extraorally (Pohl *et al.* 2001).

The most frequent type of resorption resulting from major damage to periodontal ligament cells is replacement resorption, leading to dentoalveolar ankylosis (Moffat *et al.* 2002). Ankylosis is usually observed within 1–2 months, but it may not be diagnosed until more than 6 months have elapsed (Barrett & Kenny 1997, Gregg & Boyd 1998). Radiographic changes are seldom present initially and are more difficult to assess (Andersson *et al.* 1984). In the present case, ankylosis was detected clinically and radiographically after 5 months.

Development of ankylosis after transplantation may be associated with a number of factors, including:

1. Time elapsed between the extraction and reimplantation of the tooth into the prepared socket (Andreasen 1981a, Andersson *et al.* 1984, Moffat *et al.* 2002). Even though all procedures in the present case were completed in a short period of time, it was believed that this may have been a pre-disposing factor.

2. Damage to the root surface occurring during the surgical procedures (Kristerson & Lagerstrom 1991). Although all attention was paid to minimize root-surface damage all surgical procedures carry some risk of tissue injury and may have been another pre-disposing factor.

3. Transplantation of a tooth into an artificially-created or modified socket (Tsukiboshi 2002). Optimal periodontal ligament (PDL) healing is seen when an avulsed tooth is replaced into its own socket. In this situation, reattachment occurs in 2 weeks between the connective tissues of the root surface and recipient socket wall (Löe & Waerhaug 1961, Nasjleti *et al.* 1975, Andreasen 1980, Proye & Polson 1982). While not as predictable, PDL healing is also expected when a donor tooth is immediately placed into a fresh, unmodified extraction socket (Andreasen 1981b, Shimada 1998). However, PDL healing is compromised when the donor tooth is placed into an artificially formed socket requiring more time and giving the opportunity for denuded areas of root to be colonized by bone cells (Shimada 1998). For this reason, the use of materials that promote PDL regeneration has been suggested.

The management options for an ankylosed tooth, range from leaving the tooth untreated (Biererman 1962), restoring the crown to compensate for progressive

infra-occlusion (Mullally *et al.* 1995), surgical extraction of the affected tooth (Malmgren *et al.* 1984) or removing its coronal portion (Filippi *et al.* 2001). In the present case, the decision was made to act conservatively because it was less traumatic for the child patient. It was decided to decoronate the tooth at a later date if infraocclusion became severe since this is a simple and less traumatic process than complete surgical removal. This technique allows complete preservation of the width and height of the alveolar process. In addition, vertical bone apposition is frequently observed on the top of the decoronated root (Malmgren *et al.* 1984).

Observation of ankylosis, at 24 month follow-up revealed that tooth 63 was still functioning and providing acceptable aesthetics. However, when the child undergoes more growth, it is expected that aesthetics and function may deteriorate. The treatment provided is considered to be an interim solution for space maintenance. With time the child patient may reach an age that allows alternative, more definitive treatment such as premolar tooth transplantation or provision of an osseointegrated implant.

Conclusion

Autotransplantation of a primary canine tooth may be considered as an interim treatment option for children under the age of 10 years who have lost a permanent incisor tooth. Success of primary tooth autotransplantation may be affected by a number of factors, including case selection, extra oral time, surgical and endodontic procedures.

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