Abstract: It is often very difficult to replant avulsed teeth in the deciduous and mixed dentition when the cortical bone is fractured and there are no adjacent teeth for anchorage. In this article, we describe the management of avulsed maxillary incisors in a 7-year-old boy. The avulsed teeth could be successfully repositioned by intra-alveolar transplantation using the 180° rotation (buccolingual reverse) method, which was originally applied to preserve teeth with relatively deep subgingival crown-root fracture, and a vacuum-formed splint was used for fixation. The avulsed teeth were followed up for 42 months. The post-operative course was uneventful with an aesthetic and functionally stable outcome.

Keywords: teeth avulsion; 180° rotation (buccolingual reverse) method; vacuum-formed splint.

Introduction
Tooth avulsion is relatively common in children and the maxillary anterior teeth are most frequently affected (1). In case of permanent tooth avulsion, replantation of the avulsed teeth is recommended from functional and aesthetic view points (2). However, it is difficult to stabilize avulsed teeth in the deciduous and mixed dentition when adjacent teeth are not available for anchorage and cortical bone of the tooth socket is fractured (3). In such cases, replantation of the avulsed teeth is often not performed.

Intra-alveolar transplantation using the 180° rotation (buccolingual reverse) method was originally applied to preserve teeth with relatively deep subgingival crown-root fracture (4,5). This method aims to settle the fractured root in a more coronal position for subsequent dental treatment. According to this method, the fractured root is extracted carefully, and then reinserted into the socket with intentional 180° rotation. As the shape of the root is not symmetric, naturally the root apex does not reach the bottom of the socket and is positioned more coronally. Prosthetic treatment can be easily performed because the root is slightly extruded against the socket. The stability of the reinserted root is generally satisfactory although the tooth has been extracted once (4,5).

There are no previous studies reporting the application of the 180° rotation method to avulsed teeth. In this case report, we describe the successful replantation of avulsed maxillary incisors that were repositioned by 180° rotation of the roots and fixed using a vacuum-formed splint.

Case Report
A seven-year-old boy visited our clinic for the management of maxillary teeth avulsion. Two hours earlier, he had accidentally fallen down some stairs and two of his maxillary teeth had come out. The avulsed teeth were retrieved after 10 min and brought to our office immersed...
in tap water. On intraoral examination, his left maxillary central and lateral incisors were avulsed and the labial cortical bone of the sockets was fractured (Fig. 1a). The adjacent right central incisor had not fully erupted, and left and right deciduous canines were mobile. The root development of both avulsed teeth was incomplete (Fig. 1b). Although we tried to reposition the avulsed teeth, the right position could not be found because of the fractured cortical bone. We were about to abandon replantation, when we finally tried to reposition the root of the teeth by rotating it $180^\circ$ (buccolingual reverse) against the sockets. Fortunately, both roots could get relatively
stable footholds in the sockets and were retained. After obtaining the consent of the patient and his mother, we decided to replant both incisors in the 180° rotated position. As there were no anchorage teeth, we fabricated a vacuum-formed splint for fixation (3,6). After temporary fixation of the avulsed teeth in the mouth with self cure resin, an impression was taken to make a plaster model (Fig. 2). A 0.6 mm-thick acrylic sheet (Erkodur, Erkodent Erich Kopp GmbH, Pfalzgrafenweiler, Germany) was used to make the vacuum-formed splint on the model (Fig. 3a, b). The vacuum-formed splint was applied for 4 weeks. During this period, root canal treatment of the
teeth was performed with calcium hydroxide (Figs. 4, 5a, and b). After 18 months, the avulsed teeth were covered with resin jacket crowns and were followed up for 42 months. The post-operative course was uneventful with an aesthetic and functionally stable outcome (Fig. 6a, b).

**Discussion**

Intra-alveolar transplantation using the 180° rotation method is one of the treatment options for teeth with deep subgingival crown-root fracture. Teeth with periodontal disease, high mobility and gingival inflammation are contraindications (7). This method is rapid and safe, whereas orthodontic extrusion requires more time and cost. The disadvantages of this method are the risk of root resorption and reduction in crown-root ratio (4).

In this case, we applied the intentional 180° rotation method to the avulsed teeth and the outcome was favorable. When we encounter cases of avulsion with fractured cortical bone, the 180° rotation method may be effectively applied for repositioning of the tooth.

As for fixation in case of avulsion in the deciduous and mixed dentition, it is difficult to ensure patient cooperation, the adjacent tooth gaps are often wide and only minimal anchorage and support would be available from the adjacent teeth. In such cases, a vacuum-formed splint, which is made from acrylic on the cast model, is an exceedingly useful appliance. The advantage of a vacuum-formed splint is that the avulsed teeth are positioned appropriately though it takes time to make the splint in the dental laboratory. In the present case, there were no complications, such as interference of articulation or inadequate oral hygiene, during the period the vacuum-formed splint was being used (3,8).

Replantation of avulsed teeth in children has obvious advantages; however, ankylosis of a replanted tooth may interrupt normal growth of the alveolar process (9,10).

Long term follow-up of the involved tooth and supporting structures is required after replantation in children.

**References**