Developmental disturbance of a mandibular central incisor following trauma to the primary predecessor

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Abstract: When a primary tooth sustains a traumatic injury, development of the permanent tooth can be disturbed, leading to various malformations. This case report details the 7-year follow-up of a developmental anomaly of a central mandibular incisor in a 10-year-old Japanese girl with a history of dental trauma that had occurred at age 4. The trauma had resulted in unusual crown dilaceration in the permanent successor, which exhibited a discoloured and abnormal crown morphology. Radiographic examination revealed crown dilaceration of the tooth, which had a curved root canal.

Keywords: crown dilaceration; dental trauma; developmental disturbance; mandibular incisor; primary tooth.

Introduction

Traumatic injuries to teeth are frequent during childhood and have shown to result in problems with endodontic therapy. The close topographic relationship between a primary tooth and its developing permanent successor suggests a risk of malformation in the permanent tooth (1). Smith and Rapp have shown that the hard tissue barrier between a primary incisor and its successor has a thickness of less than 3 mm, and appears to consist of connective fibrous tissue (2). Disturbances in the development and eruption of permanent teeth have been well studied, and the incidence of malformation is reportedly between 12% and 69% (3,4). The type of malformation is influenced by the developmental process of the permanent tooth and the severity of the trauma (1). Enamel hypoplasia (5), crown dilaceration (6), root malformation (7) and odontoma-like teeth (8) may be considered as possible sequelae. Crown dilaceration can result from an intrusion of the primary tooth at an early age, when half the crown has formed. Subsequent to invasion of the partially formed follicle by the apex of the intruded incisor, the mineralized portion of the crown twists linguually over the papilla.

The primary teeth most susceptible to traumatic injury are the maxillary incisors. Any traumatic damage to primary maxillary incisors tends to be severe, because of their site of eruption in the dental arch (4). On the other hand, few reports have documented developmental disturbances of mandibular permanent incisors (6). Management of mandibular incisors is often difficult in comparison with maxillary incisors because of the difference in root canal morphology. Therefore, it is important for practitioners to understand the anatomic characteristics of the pulpal chamber and the root canals of these teeth.

This case report details the endodontic and esthetic treatment strategies for a malformed mandibular central tooth with a curved root canal, resulting from traumatic injury in a child, and the results of a 7-year follow-up.
Case Report

A 10-year-old Japanese girl was referred to the Endodontic Department of Nihon University School of Dentistry by her local dentist for treatment of a malformed mandibular incisor (tooth 41). The patient presented because of poor dental esthetics, tongue irritation and difficulty with both incising and cleaning of the affected tooth. She was physically healthy and had no history of serious disease. However, 6 years previously, she had suffered anterior traumatic injury as a result of falling down some stairs. She had presented to a general dentist as an emergency case soon after the injury, and had undergone radiography and routine examination. Her parents were then advised of possible secondary abnormal development of the permanent teeth, and consented to treatment.

On initial clinical examination, the tooth 41 exhibited discoloration and an abnormal crown morphology, with a plaque-retentive area causing gingivitis on the lingual side (Fig. 1). The gingival probing depth was approximately 2 mm. The patient complained of cold-provoked
pain in the affected tooth. Radiography showed that the tooth 41 had crown dilaceration with a curved root canal (Fig. 2). There were no pathological symptoms in the periapical area, and the tooth responded normally to electrical vitality testing, but a sharp response to cold testing was elicited. Initially, removal of the discolored tooth and preparation to create a self-cleansing area and an esthetic appearance was considered. Esthetic restoration with a light-cured composite resin was performed on the tooth 41 during eruption of the other teeth. Two weeks later, however, the patient complained of severe discomfort in the mandibular incisor area. Symptomatic irreversible pulpitis was diagnosed, and pulp extirpation was planned.

The tooth 41 was anesthetized with a local injection of lidocaine with 1:100,000 epinephrine, and a dental rubber dam was applied. An access cavity was prepared with a high-speed diamond bur with water cooling, and pulp extirpation was performed using H-files (Mani Inc., Utsunomiya, Japan). Flaring of the root canal entrance was completed using Gates-Glidden drills nos. 1 to 3 (Mani Inc.). Tooth length was measured using an electronic apex locator and radiography. The root canal system was prepared to a size 35 by the step-back technique. During preparation, the root canal was irrigated with 2.6% sodium hypochlorite solution after each instrument. The root canal was then dried with paper points, and the access cavity was temporarily sealed with Cavit (3M ESPE, Seefeld, Germany). One week later, when the tooth was asymptomatic, the root canal was obturated with gutta-percha points and a zinc oxide-eugenol sealer using the lateral condensation technique. The patient was recalled for periodic checkups, and healing was uneventful (Fig. 2). At one year after the trauma, the tooth 41 was restored using a light-cured composite resin. At the 7-year follow-up point, the tooth showed no abnormality either clinically or radiographically (Figs. 2, 3).

**Discussion**

The treatment strategy following traumatic injury to a primary tooth is determined by concern for the safety and esthetics of its permanent successor. Traumatic sequelae can be observed in the coronal area, such as structural changes related to enamel hypoplasia, crown dilaceration and white, yellow or brown coronal discoloration. The phenomenon of crown dilaceration constitutes 3-9% of all traumatic injuries to developing permanent teeth, and this may lead to intrusion or avulsion of their primary predecessors. This occurs when some calcified matrix is moved as a result of displacement of the deciduous tooth. The position of this previously calcified incisal matrix alters, while the remaining apically soft matrix remains unchanged. Minor trauma can cause bleeding of the dental papilla, and this may be associated with crown discoloration due to incorporation of the degraded hemoglobin into the hard tissue matrix of the tooth (6). In the present case, the nature of the injury was unclear as the patient had no clear memory of the accident. The traumatic injury occurred during development of the mandibular incisor crown, as recognized from the discolored and abnormal crown of the tooth 41.

The age of a child at the time of an accident, and the severity of the injury to a primary tooth, have a bearing on the frequency and type of the resulting malformation in its permanent successor (3). Such malformations have been reported subsequent to intrusion of primary incisors in children between the ages of 1 and 3 years. The germs of permanent teeth are particularly sensitive in the early stages of development between the ages of 4 months and 4 years (3). Crown dilaceration can result from intrusion of a primary incisor when a child is around 2 years old, when half the crown has been formed. With the beginning of root development, between the ages of 4 and 5 years, the root becomes vulnerable to deformation, which can range from minor dilaceration to complete arrest of root development (6). In the present case, the patient had sustained luxation injury to the primary mandibular central incisor at around 4 years of age.

The treatment plan for the tooth 41 involved removal of the discolored tooth and preparation of the tooth to create a self-cleansing shape and an esthetic appearance. Considering the radiographic findings and the patient’s age, restorative treatment was the first choice, and an esthetic restoration using light-cured composite resin was performed. Two weeks after crown restoration, the patient returned with severe pain in the mandibular central incisor region. From a clinical standpoint, it is difficult to accurately determine the inflammatory condition of the pulp, and whether or not it is treatable. However, it is generally accepted that teeth with relatively severe pain have irreversible pulpitis, and that therefore pulp removal is necessary to relieve the symptoms and prevent apical periodontitis. Accordingly, we decided to perform pulp extirpation to rescue the tooth. Pain symptoms are often a challenge to manage, and mandibular incisors can sometimes be especially problematic in this respect as they are small and have a complicated root canal anatomy. The major difficulty in treating these teeth is the traditional
access opening location on the lingual aspect of the tooth. For lingual access in mandibular incisors, straight-line access facilitates location and debridement of the root canals, and conserves the tooth structure. It is recommended that traditional access from the lingual side should be moved as far toward the incisal direction as possible, thus allowing better access to the curved canal and better preparation of the root canal. Finally, adequate instrumentation and obturation procedures are necessary for successful endodontic treatment.

The choice of an appropriate restoration is considered to influence the prognosis of extensively damaged endodontically treated teeth. According to the literature, the final crowns transfer their load distribution to the roots, and the importance of their bracing or casting action has been stressed. The ferrule part of the crown provides sufficient retention for the restoration, and protects the remaining tooth from fracture forces (9). In the present case, a crown ferrule height of 2 mm was prepared around the sound dentin. Also, the choice of post-core materials must be considered. The properties of new materials that combine glass fiber with an epoxy resin matrix have been investigated. These materials have high mechanical resistance and their modulus of elasticity is similar to that of dentin. Recent advances in adhesive procedures have allowed better reinforcement of the remaining tooth structure. However, long-term clinical data are scarce. A few clinical studies have reported that glass fiber-reinforced composite posts retain their strength over periods longer than 3 years (10). To protect fractures from occlusal loads, it is advised to make endodontically treated teeth more resistant by preserving as much coronal wall dentin as possible and providing a ferrule as part of the crown.

It is well known that traumatic injury of primary teeth can lead to malformation of the underlying permanent teeth. Correct diagnosis and an appropriate treatment strategy are mandatory to prevent future complications associated with injury to primary teeth.

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References