ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN-POLONIA
VOL. LXI, N1, 45 SECTIO D 2006

Chair and Department of Jaw Orthopedics
Department of Histology and Embryology, Medical University of Lublin
Laboratory of Electron Miscroscopy, Catholic University of Lublin

IZABELLA DUNIN-WILCZYŃSKA, BARBARA JĘDRYCH,
BARBARA JĘDRYCH-GÓRSKA, HENRYK SKRZYPEK

Fused tooth in scanning electron microscope

Fused teeth occur relatively rarely in permanent dentition, from 0.1 to 0.2% (7). Fusion means a connexion of two or more tooth buds. The tooth has a varying degree of common tissues depending on the developmental stage at which the fusion occurred (2). Most frequently a fused tooth has common enamel and dentine but two pulp chambers and canals (1), or it may also have a common pulp chamber and two root canals (4). Complete fusion of buds before mineralization leads to the formation of one big tooth with one pulp chamber and one root (6). Fused teeth are extracted in most cases; however, there were attempts to separate and remove the smaller part leaving the larger tooth fragment in the mouth, provided with a biological dressing of the dentinal part. The aim of the study was a microscopic assessment of a fused tooth in view of a possibility of separating such a tooth and leaving one of the parts in the mouth.

MATERIAL AND METHODS

The object of the study was the left central incisor removed for aesthetic reasons in an 8-year-old girl after a detailed clinical and radiological examination. The patient's records included study models, a panoramic radiograph (DPT), a periapical radiograph and CT scans. The scans were performed in the horizontal plane (24 scans from top to bottom) and in the frontal plane (16 scans from front to back) every 2 mm.

The noticeably enlarged crown of the fused tooth consisted of the smaller mesial part and the larger distal part, and their union manifested itself with bending of the vertical margin of the enamel and rotation of the coronal components. Measurements of crown width were performed with the use of a slide caliper exact to 0.1 mm. After extraction the tooth was incised in the frontal plane. The root canals were filled with a dye, 3% aniline blue, by means of a syringe. The penetration of the dye revealed the shapes and number of chambers. The other tooth fragment was cleansed with ultrasonic washer and the structure of enamel and dentine was evaluated by means of a scanning electron microscope LEO 1430 VP in areas unaffected by the incision, and the results were compared with those of a tooth with a normal structure.

RESULTS

The clinical and radiological examination revealed an atypical structure of a left central incisor (Fig. 1). The measurement test showed that the tooth's width was 14.8 mm. It was composed of the smaller mesial part (6.1 mm) and the larger distal one (10.9 mm) located at an angle each to the other. The sum of crown widths of two parts was greater than the measurement of the entire crown width due to the eminence of the enamel on the border of the junction, which added to the transverse measure of the crown. DPT and periapical radiograph did not prove helpful in determining the inner structure of the tooth because of rotations of components. Superimposed

shadows of the lateral incisor made it difficult to interpret radiographs. Only CT showed that the tooth had a common chamber and two root canals (Fig. 2). Staining one half of the fused tooth with 3% aniline blue confirmed the presence of one common chamber and two root canals (Fig. 3). An examination of the tooth under a scanning microscope revealed differences in the structure in comparison with a normal tooth.

Fig. 1. Fused left central maxillary incisor impairs esthetics

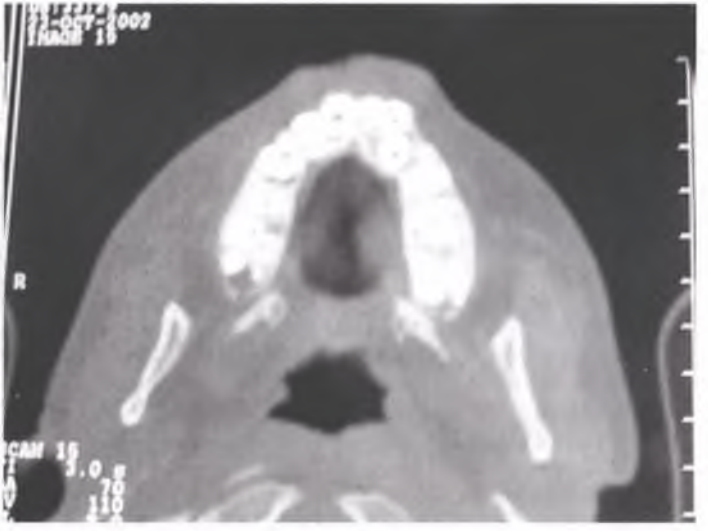

Fig. 2. ACT scan of the fused tooth in the horizontal plane

Enamel of the tooth with a normal structure consisted of tightly packed hexagonal prisms of enamel with the diameter ranging from 4 to 8 μm. Enamel prisms were situated parallel and were winding one round another in the vicinity of dentine. Each prism of enamel ran through the whole enamel layer, except the thick peri-dentinal layer and the tooth neck area. The narrow spaces between adjacent prisms were occupied by interprismatic spaces (5) (Fig. 4A).

Fig.3. Staining of the tooth section with 3% aniline blue

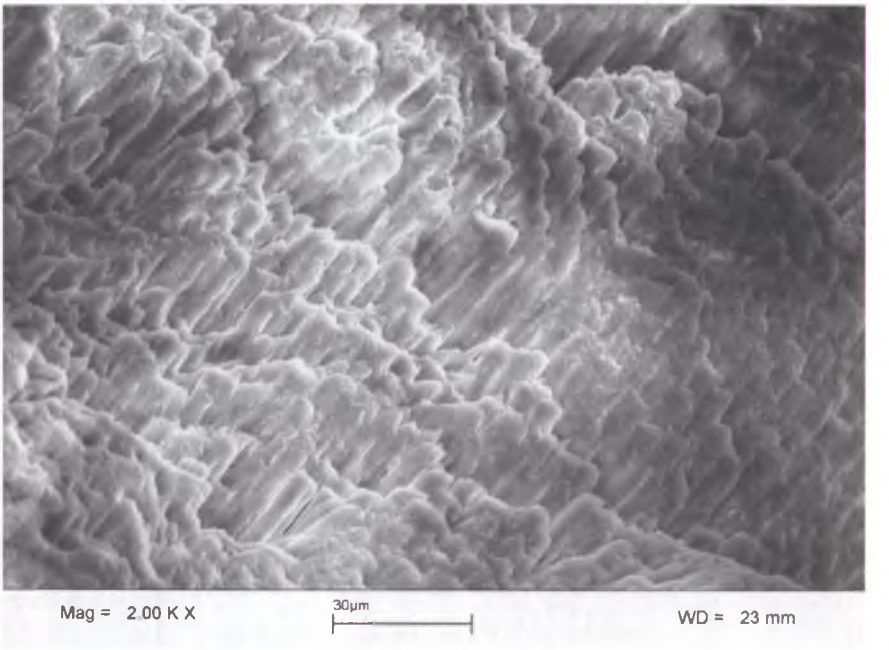

Fig. 4A. Enamel structure of a typical tooth

Dentine in a healthy tooth was composed of intertubular and peritubular dentine and regularly spaced microscopic dentinal tubules. Lumen of the tubules was generally round, their diameter ranged from 3-5 μm with the pulp measuring 1 μm in the external part (Fig. 4B).

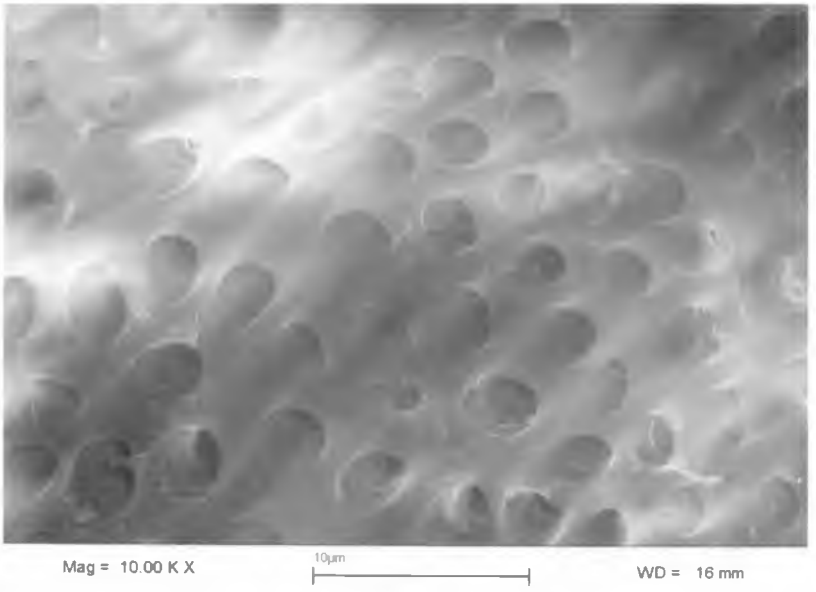

Fig. 4B. Dentine of a healthy tooth

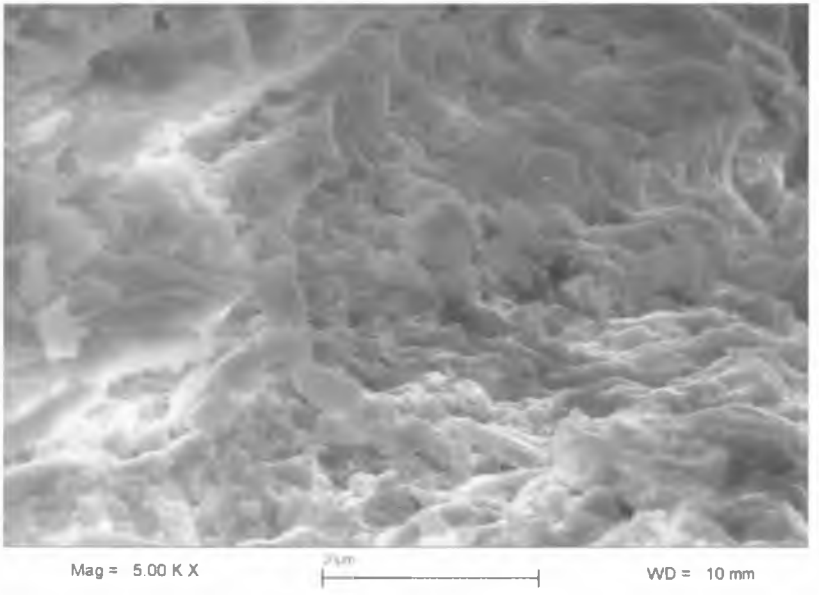

Fig. 5. Region of connection from the larger aspect

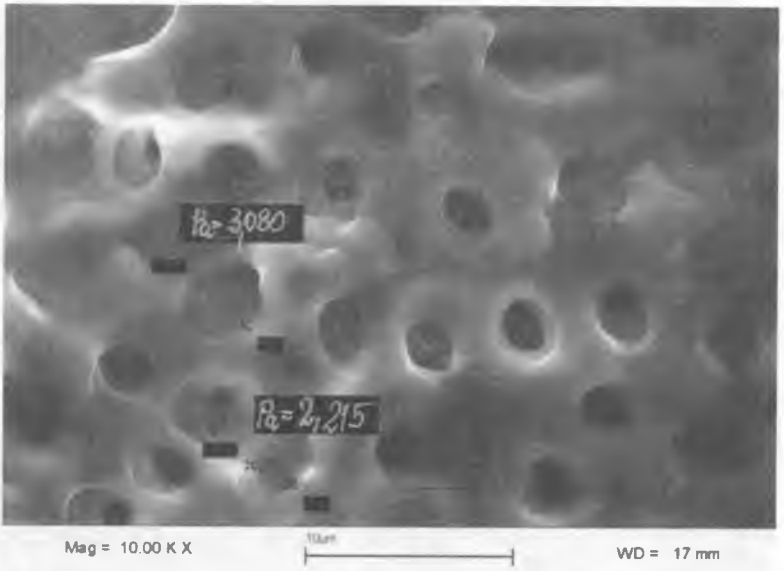

Fig. 6A. Coronal dentine of the smaller part

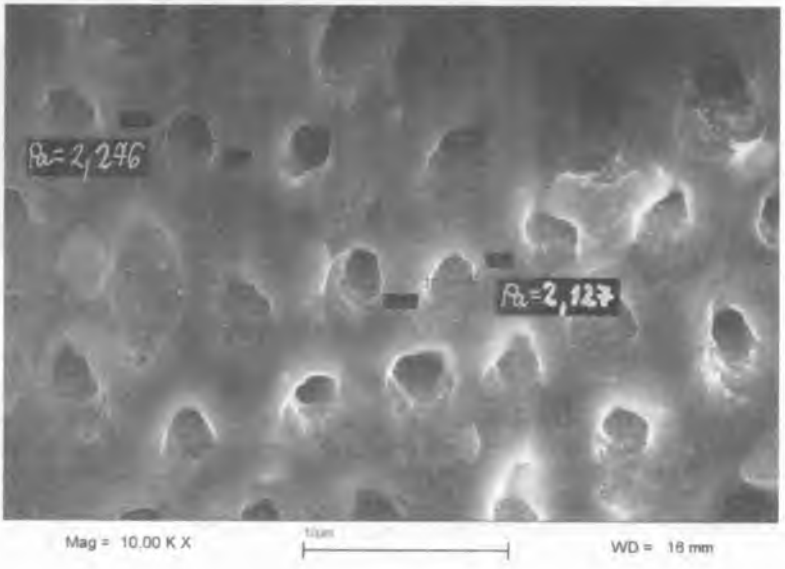

Fig. 6B. Coronal dentine of the larger part

In the examined tooth differences were found between the smaller and larger parts and the fusion area. In the enamel of the smaller part of the fused tooth, in its internal and external region, there were areas where the prisms had irregular course. Only some of the prisms had a parallel course. The prisms did not have the same thickness. The conducted measurements revealed that their thickness ranged from 2.98 to 5.43 μm. Enamel of the larger fragment of the fused tooth had

a normal structure. The prisms were situated parallel. The diameter of prisms was about 4 μm. The interprismatic spaces showed uniform width. Enamel of the fusion area on the side of the smaller fragment presented a regular prismatic structure. The majority of the prisms ran parallel and the rest slanted. The prisms were 4.4 μm thick. The fusion area on the side of the larger fragment revealed abnormalities in the structure of prisms. Structures with an irregular, winding course resembled bundles of enamel (Fig. 5). In the chamber dentine of the smaller part the arrangement of tubules was not regular. The majority of the tubules showed a curved course in different directions. Individual tubules presented unmineralised dentine in their initial segment. The diameter of the tubules was 2 to 3 μm (Fig. 6A). The surface of intertubular dentine was rough and creased. Dentine in the coronal region of the larger tooth fragment presented an arrangement of regularly spaced tubules. The diameter of initial segments of the tubules was about 2.1 μm (Fig. 6B). The direction of tubules was uniform. Intertubular dentine was delicately undulating. Dentine in the coronal part of the fusion area presented a less regular arrangement than in a normal tooth. The initial segments of the tubules revealed apparent unmineralized dentine. The diameter of the tubules was about 2.8 μm. Intertubular dentine was delicately creased.

Fig. 7A. Radical dentine of the smaller part

The most pronounced changes were observed on the surface of radical dentine of the smaller tooth part, whose structure resembled sclerotic dentine. It was uneven and deprived of tubular lumen (Fig. 7A). One could not distinguish between surfaces, intertubular from peritubular. In the bigger tooth fragment the arrangement of tubules in radical dentine was not so regular. Initial segments of individual tubules had unmineralized dentine. The course of the observed structures was multi-directional. The diameter of tubular lumen ranged from 2.2 to 2.6 μm (Fig. 7B). There was no unevenness within intertubular dentine. In the fusion area at one third of the root length, dentine showed fewer and fewer tubules. Initial segments of tubules had irregular shapes. Tubular lumen was decreased compared with coronal dentine, the diameter of tubules was 1.6 to 2.4 μm. Intertubular dentine was smooth. The dentine of the lower part of the root in the fusion area presented a small number of irregularly distributed tubules. The lumen of a part of those tubules was overgrown. Numerous creases of the intertubular dentine were observed, the majority of which were parallel to the long tooth axis.

Fig. 7B. Radical dentine of the larger part

DISCUSSION

Fused teeth reveal macroscopic structure abnormalities and constitute a disturbance of dental arch aesthetics. In the examined tooth apart from abnormal appearance, abnormalities of internal structure were observed. There were more abnormalities within the smaller fragment of the fused tooth; they concerned the enamel and coronal and radical dentine.

In the literature the structure of fused teeth was assessed under a light microscope. At the fusion area pits and cracks were found in the enamel and dentine. The fusion area had irregular structure which referred to both dentine and cementum (3). The region of the junction was also described by O'Reilly (4). He observed numerous vascular spaces between the roots. He found a few odontoblasts in the smaller part of the root. Similar results were obtained in the studied fused tooth. The structure of radical dentine in the area of fusion also points to the absence or damage to odontoblasts, which resulted in sclerotic dentine. Irregular structure was observed in both enamel and coronal dentine.

Therapeutic management of fused teeth varies because of low incidence and variability of structural changes. One of the managing options is extraction of the fused tooth. Separating the fused fragments is not recommended as both parts present an abnormal structure. The authors have not found a description of the structure of a fused permanent tooth seen under a scanning electron microscope so far; all the previous studies examined a fused tooth under a light microscope after initial decalcification. A similar study was performed on teeth affected with amelogenesis. Those teeth were also cut apart with water-cooled diamond disc and broken in the areas of hypoplastic enamel. Importance was attached to that the studied enamel was not to be affected by the incision. Subsequently, tissues were evaluated under a scanning microscope. Similar procedures were executed in the case of our fused tooth.

CONCLUSIONS

1. The studied fused tooth presented an abnormal structure, both internal and external, especially within the smaller fragment.

2. The abnormal microscopic structure may be the result of either developmental disturbances or the pressure exerted on the smaller part of the fused tooth by the larger fragment during growth.

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SUMMARY

The aim of the study was an assessment of the microscopic structure of a fused tooth. The object of the study, i.e. a left central incisor with an atypical structure, was removed for aesthetic reasons in a girl aged 8 years. The macro-and microscopic structure of a fused tooth was analysed. The medical records included intraoral photographs, study models and radiographs [dental panoramic radiograph (DPT), periapical radiograph, and CT scans]. An incision was performed in the frontal plane of the extracted tooth with a diamond separator and half the tooth was stained with 3% aniline blue. The intrinsic structure of the enamel and dentine was evaluated by means of a scanning electron microscope LEO 1430 VP. It was found that the crown of the tooth was 14.8 mm wide and consisted of the smaller mesial part and the larger distal part, which were situated at an angle to each other. CT scans performed every 2 mm in the frontal and horizontal planes revealed a common pulp chamber and two root canals. The staining of half the tooth with 3% aniline blue was in accordance with the results obtained from CTs. An examination with a scanning microscope revealed an abnormality in the structure of the enamel in the form of irregular arrangement of prisms of unequal thickness and changes in the coronal dentine (irregular arrangement of tubules, the surface of intertubular dentine rough and creased). The radical part of dentine resembled sclerotic dentine. The abnormalities were more pronounced in the smaller mesial part of the tooth. The fused tooth presented an abnormal structure both macro and microscopically. Structure abnormalities could be the result of developmental disturbance or pressure exerted on the smaller fragment by the larger part of the tooth.

Ząb zlany w mikroskopie skaningowym

Celem pracy była ocena budowy mikroskopowej zęba zlanego. Przedmiotem badań był siekacz przyśrodkowy lewy o atypowej budowie, usunięty ze względów estetycznych u dziewczynki w wieku 8 lat. Analizowano makro- i mikroskopową budowę zęba zlanego. Dokumentacja obejmowała fotografie wewnątrzustne, modele diagnostyczne i zdjęcia radiologiczne

(pantomogram, radiowizjogram i tomografię komputerową). Na usuniętym zębie dokonano cięcia w płaszczyźnie czołowej separatorem diamentowym, a połówkę zęba zabarwiono 3% błękitem anilinowym. Strukturę wewnętrzną szkliwa i zębiny oceniano za pomocą skaningowego mikroskopu elektronowego LEO 1430 VP. Stwierdzono, że szerokość korony zęba wynosiła 14,8 mm i złożona była z części mniejszej mezjalnej i większej dystalnej, które względem siebie były ustawione pod pewnym kątem. Tomografia komputerowa wykonana w płaszczyźnie czołowej i poziomej co 2 mm wykazała, że ząb miał wspólną komorę miazgi i dwa kanały korzeniowe. Zabarwienie połówki zęba 3% błękitem anilinowym zgadzało się z wynikami uzyskanymi za pomocą tomografii. Badanie mikroskopem skaningowym wykazało zaburzenie budowy szkliwa w postaci nieregularnego przebiegu pryzmatów o niejednakowej grubości oraz zmiany zębiny koronowej (układ kanalików nieregularny, powierzchnia zębiny międzykanalikowej nierówna i pofałdowana). Część korzeniowa zębiny przypominała zębinę sklerotyczną. Zmiany były wyraźniejsze w części mniejszej mezjalnej zęba. Ząb zlany wykazywał nieprawidłową budowę zarówno makro- jak i mikroskopową. Zaburzenia w budowie mogły być spowodowane zaburzeniami w rozwoju lub uciskiem na część mniejszą większego fragmentu zęba.