CLINICAL CASE

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Tooth Extracted from the Cleft of Primary and Secondary Palate in Morphological Observations – Case Report

Budowa histologiczna zęba usuniętego z rozszczepu podniebienia pierwotnego i wtórnego – opis przypadku

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Abstract

The aim of this paper was the evaluation of three teeth extracted from the cleft of primary and secondary palate and from its surrounding. Investigations concerning surfaces of sagittal cuts of teeth observed in light microscope and in scanning microscope (type Jeol-JSM-35-CF) were made after it was covered by gold in vacuum. Morphological abnormalities of enamel and dentine were observed only in tooth extracted from the cleft. No abnormalities were observed in teeth extracted from the surrounding, of the cleft. Structural and substructural abnormalities of the tooth extracted from the cleft were probably connected with environmental changes during appropriate stages of its development (**Dent. Med. Probl. 2011, 48, 2, 270–275**).

Key words: palate cleft, tooth, morphological abnormalities.

Streszczenie

Celem pracy był opis histologiczny trzech zębów usuniętych z rozszczepu podniebienia pierwotnego i wtórnego oraz z jego otoczenia. Badania dotyczyły powierzchni po strzałkowym cięciu zęba. Oceniono je w mikroskopie świetlnym i skaningowym (typ Jeol-JSM-35-CF) po pokryciu ich warstwą złota. Nieprawidłowości morfologiczne szkliwa i zębiny stwierdzono tylko w zębie usuniętym z rozszczepu. Nie wykazano nieprawidłowości histologicznych w zębie usuniętym z otoczenia rozszczepu. Nieprawidłowości anatomiczne i histologiczne zęba usuniętego z rozszczepu były prawdopodobnie związane ze zmianami środowiskowymi podczas odpowiednich stadiów jego rozwoju (**Dent. Med. Probl. 2011, 48, 2, 270–275**).

Słowa kluczowe: rozszczep podniebienia, ząb, nieprawidłowości morfologiczne.

Primary cleft palate (premaxilla with alveolar process and upper anterior teeth, anterior part of the oral vestibule, frontal part of the nose base) and secondary cleft palate (alveolar processes of maxilla, hard palate, soft palate, uvula) are common congenital developmental anomalies of facial part of the skull. The presence of a cleft – uni- or bilateral, localized to lip, alveolar process and palate – is very characteristic. Among 374 579 live infants inspected in Poland in 1998–1999 primary and secondary clefts were found in 644 (0,17%) children. The frequency of this disorder is 1 : 500 in American Indians, 1 : 1000 in Caucasian race, 1 : 2500 in those of African origin [1].

In the 4th to 10th week of fetal life endo- and ectodermal tissue in the facial region is damaged due to a lack of mesodermal tissue. Because of this damage a cleft is produced. The etiology of clefts is multifactorial, environmental factors are superimposed on the genetic basis [2]. In 1994 Souren and Prahl-Andersen [3] found, according to 106 orthopantomographic tests performed on

children with clefts, that its origin is connected with delayed growth and development of part of the teeth-facial region.

The literature concerning clefts usually refers to epidemiologic investigations, clinical cases and team treatment: surgical, orthodontic, prosthetic and rehabilitation [4]. For optimal orthodontic results previous surgical treatment is more profitable.

Furthermore, authors focus on clefts associated with lips and palate:

1. Other developmental disorders whose occurrence is 14%:
   - congenital missing teeth (CMT), especially in the cleft region (upper incisors and premolars, as well as lower premolars) [5–8]),
   - changed shape of lateral incisors in 10% of children (plug teeth) [7]),
   - presence of natal, neonatal and supranumerary teeth in 3% of children [7, 9],
   - presence in such syndromes as: Thurston, Van der Woode and polycystic kidney disease with amelogenesis imperfecta [10, 12],
   - malformation of dental enamel.
2. Early or late sequences of:
   - ectopic teeth eruption [7, 13],
   - transposition of upper canines and premolars in 8% of children [7],
   - palatal displacement of upper canines in 1% of children,
   - ankylosis of deciduous teeth.
3. Greater possibility of:
   - Injury hazard of this region of the oral cavity [14],
   - Tendency to considerable accumulation of dental calculus.

An interesting clinical case was described by Pradel et al. [15] concerning spontaneous tooth eruption after surgical treatment of the cleft with biomaterial implantation. Based on this case, the author suggested that the presence of the biomaterial led to ossification of the alveolar process in this region which caused physiological tooth eruption [16].

The only author who morphologically investigated teeth from the cleft were Lagarde et al. in 1987. They found the following structural changes in these teeth: malformation of the enamel with accompanying decreased mineralization. Furthermore, they described microradiographically prenatal enamel that was more mineralized than postnatal one. In microanalytical observations they affirmed a higher rate of calcium according to phosphorus, a higher level of calcium and lower levels of phosphorus and magnesium [16].

The aim of this paper is to evaluate morphologically 3 teeth, which had been extracted from a primary and secondary palate cleft and its surroundings in a male patient. At notification the lack of teeth 13, 11, and 21 was observed in patient's mouth.

Case Report

Three teeth: 14, 12 and 22 were extracted from an 11-year-old boy due to orthodontic indications in the Department of Oral Surgery Jagiellonian University, Cracow. Tooth 12 was located in the cleft, the other in the neighboring tissue. The patient was born in 1995 with a right-sided primary and secondary palatal cleft. He was first treated at the age of 10 months in the Institute of Pediatrics. At the age of 7 years plastic surgery was performed on his nose and subsequent surgery 2 years later (Figs. 1–4).

Light and scanning electron microscope evaluation of those 3 teeth was carried out. Teeth were sectioned sagitally. Cuts were polished and covered with gold in vacuum. Samples were then observed in SEM (Jeol-JSM-35CF type). After SEM image acquisition samples were ground into thin sections for light microscopy evaluation. The grinding was performed on constructed for those investigations grinder, using a gradation of grinding papers. Finally cuts were smoothed with appropriate polishing diamonds in a water spray.

Teeth 14 and 22 did not reveal any changes in structure or substructure when observed in light microscope and on SEM images. However evident changes were observed in tooth 12 which was located in the cleft. Clinically the apex of the tooth was curved (Fig. 5).

On cuts observed in the light microscope the enamel structure, in the upper part of the crown revealed a sudden abberation in the region of Retzius lines and then a total lack of them was noticeable (Fig. 6). In the middle and lower part of the crown, at the dento-enamel junction (DEJ), numerous structures of Tomes's granular layer which are not normally present here were found (Fig. 7). In the middle part of tooth between its chamber and the enamel, structures looking like granules from Tomes's granular layer were visible in Owen's line. At the chamber side of the tooth a few irregular dentinal tubules were found. From the border marked by Owen's line towards the dento-enamel junction tubules were numerous, densely packed and of normal arrangement (Fig. 8). Over the chamber, crosswise to the longitudinal axis of the tooth, dentinal tubules of special diameter were observed. Other tubules of normal diameter were connected with them, however they were located more rarely than normally (Fig. 9).

Fig. 1. Patient's face after reconstructive surgery

Ryc. 1. Twarz pacjenta po chirurgii rekonstrukcyjnej

Fig. 2. X-ray of patient with cleft palate

Ryc. 2. Zdjęcie pantomograficzne pacjenta z rozszczepem podniebienia

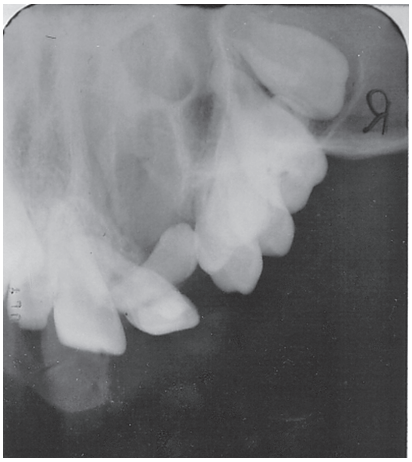

Fig. 3. X-ray of cleft palate region

Ryc. 3. Zdjęcie RTG rejonu rozszczepu podniebienia

SEM images of dentine above the Owen's line confirmed a normal arrangement of dense, parallel dentine tubules. Only a few tubules contained Tomes's fibers (Fig. 10). Above the tooth chamber larger spaces of intertubular dentine and a lower number of dentinal tubules were visible (Fig. 11).

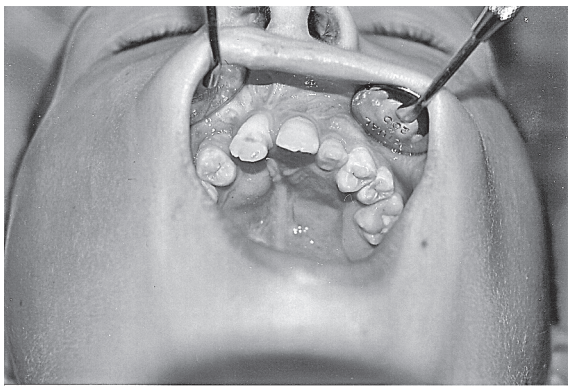

Fig. 4. Patient's dentition before extraction

Ryc. 4. Uzębie pacjenta przed ekstrakcją

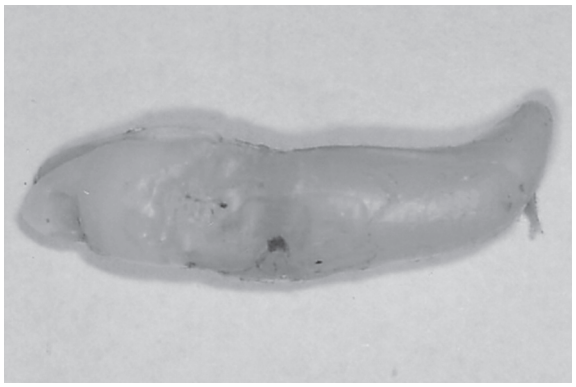

Fig. 5. Tooth extracted from the clefted palate

Ryc. 5. Ząb usunięty z rozszczepu podniebienia

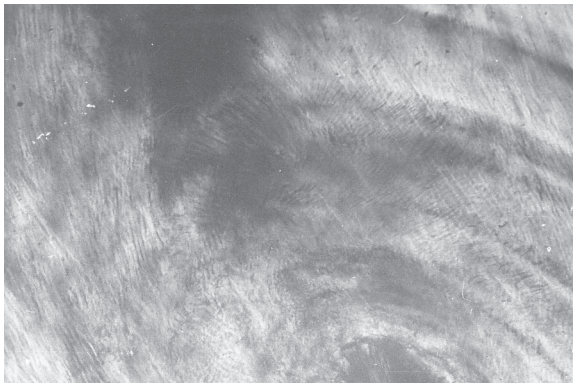

Fig. 6. Image of tooth extracted form cleft palate, cut sagittaly: in the middle part of crown, in enamel a sharp break of parallel Retzius lines is visible, lower no lines at all, magnification ×400

Ryc. 6. Obraz zęba usuniętego z rozszczepu podniebienia, cięcie strzałkowe: w środkowej części korony, w szkliwie widoczne ostre złamanie równoległości linii Retziusa, poniżej linie całkowicie niewidoczne, powiększenie 400×

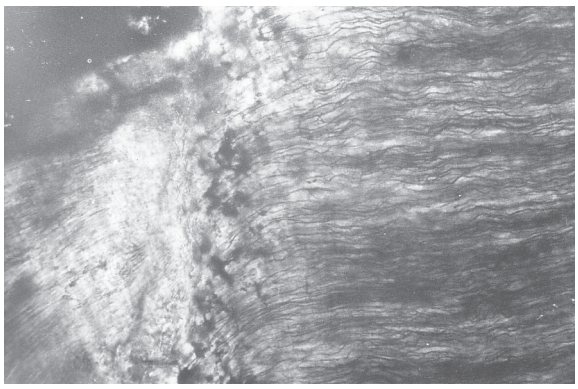

Fig. 7. Sagittal cut from the cleft palate, dentine is visible on the right, enamel on the left, in the middle, between those tissues multiple structures, typical for Tomes's layer are visible, magnification ×400

Ryc. 7. Cięcie strzałkowe od rozszczepu podniebienia, zębina po prawej, szkliwo po lewej stronie, pośrodkowo między tkankami są widoczne liczne struktury typowe dla warstwy Tomesa, powiększenie 400×

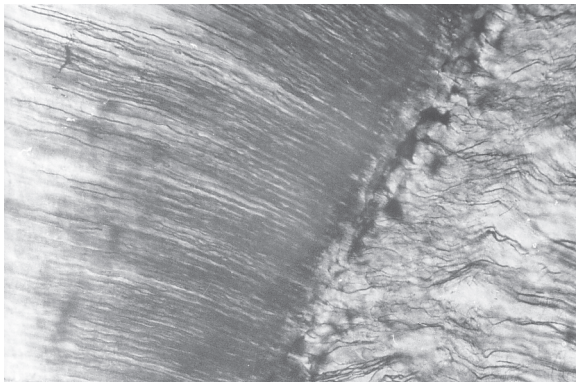

Fig. 8. Sagittal cut from the cleft palate, in the middle part, between tooth chamber and dental-enamel junction in Owen's line a border of run and arrangement of dental tubules is visible, in Owen's line granular structures may be visible, similar to ones in Tomes's layer of tooth root, magnification ×400

Ryc. 8. Cięcie strzałkowe od rozszczepu podniebienia, w środkowej części między komorą zęba a połączeniem szkliwno-zębinowym w linii Owena jest widoczna granica przebiegu i rozmieszczenia kanalików zębinowych, w linii Owena jest struktura ziarnista, podobna do warstwy Tomesa korzenia zęba, powiększenie 400×

Fig. 9. Sagittal cut from the cleft palate, over the tooth chamber very thick dental tubules may be visible, they are connected with tubules of normal diameter, which run irregularly and are rarely arranged, magnification ×400

Ryc. 9. Cięcie strzałkowe od rozszczepu podniebienia. Ponad komorą zęba są widoczne bardzo grube kanaliki zębinowe, łączące się z kanalikami o prawidłowej średnicy, które biegną nieregularnie i są rozmieszczone rzadko, powiększenie 400×

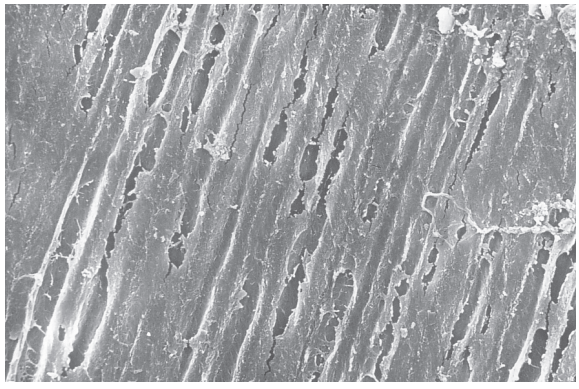

Fig. 10. SEM image. Uncovered surface of dentine above the Owen's line. Parallel run of multiple dental tubules, magnification ×2400

Ryc. 10. Obraz SEM, odsłonięta powierzchnia zębiny powyżej linii Owena, równoległy przebieg wielu kanalików zębinowych, powiększenie 2400×

SEM images of the enamel revealed distinct and normally arranged Retzius lines as well as parallel arrangement of enamel prism bundles. The interprismatic spaces were clearly marked, furthermore its crystal structure could be observed in single prisms (Fig. 12). Between the area with distinct Retzius lines and the one with blurred lines an alteration in enamel prism bundle arrangement was observed. Bundles were positioned multidirectionally and than prisms were arranged abnormally (Fig. 13).

Discussion

In our study teeth located in the neighborhood of the cleft showed normal structure and substructure. Developmental disorders were connected with the tooth located in the cleft. The development of this tooth took place under the influence of a changed environment. Abnormalities were observed in enamel and dentine, but the cementum remained unchanged. Thus the location

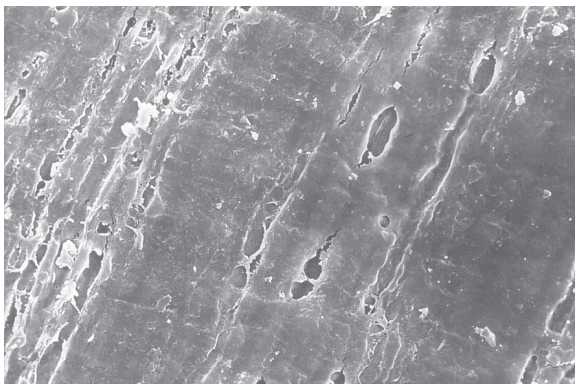

Fig. 11. SEM image, in dentine below Owen's line lower number of dental tubules, which run parallel may be visible, magnification ×2400

Ryc. 11. Obraz SEM, w zębinie poniżej linii Owena mniejsza liczba kanalików zębinowych biegnących równolegle, powiększenie 2400×

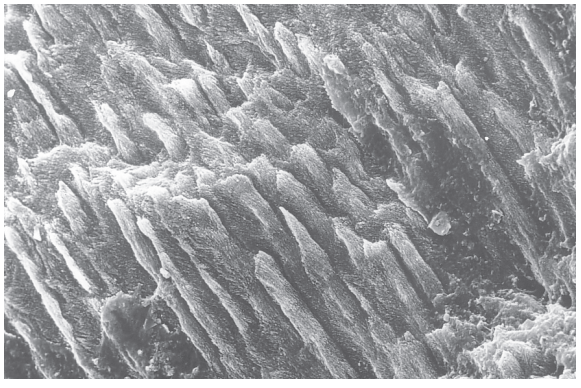

Fig. 12. SEM image, image of enamel from the place where in the cut Retzius lines run parallel, enamel prisms bundles are arranged regularly, enamel prisms are regular, magnification ×2400

Ryc. 12. Obraz SEM, obraz szkliwa w miejscu, gdzie cięcie przebiegało równolegle do linii Retziusa, pęczki pryzmatów szkliwa są rozmieszczone regularnie, pryzmaty szkliwne są regularne, powiększenie 2400×

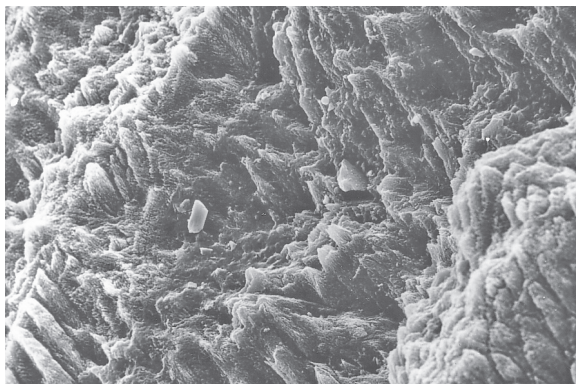

Fig. 13. SEM image, image of enamel from the place where no Retzius line were visible, irregular arrangement of enamel prisms bundles, inside which multidirectional arrangement is visible, magnification ×2400

Ryc. 13. Obraz SEM, obraz szkliwa w miejscu, gdzie nie są widoczne linie Retziusa, nieregularne rozmieszczenie pęczków pryzmatów szkliwnych, skierowanych w różnych kierunkach, powiększenie 2400×

of teeth in relation to the cleft was crucial in terms of its development.

In the tooth from the cleft an asymmetric arrangement of Retzius lines or their lack was found next to the normal lines. Enamel prisms adapted to the arrangement of those lines. In regions were Retzius line was normal the enamel prisms run regularly. Interprismatic spaces were more visible, and prisms showed its crystal structure. In those regions no Retzius lines were found, the enamel prisms run irregularly and single prisms were positioned randomly.

Numerous structures of Tomes's granular layer, or structures very similar to these, found between the enamel and dentine as well as in the dentine space between tooth chamber and the enamel normally do not exist there.

Total promiscuity of dentine tubules was characteristic for this dentine. Normally those tubules are the widest and the most numerous in regions adjacent to the pulp chamber and these parameters decline peripherally. However these parameters were totally altered in the observed tooth, in some regions this arrangement was reversed; furthermore its run was not parallel. Intertubular dentine was more frequent closer to the chamber and Tomes fibers were rarely found in the tubules.

The tooth originated in the cleft was different both macroscopically and microscopically according to its enamel and dentine. These were significant developmental disorders of tissues which constitute the tooth, including: regularity disorders, tissue moulding disorders and connected with this process mineralization disorders. Abnormal arrangement of single elements was observed – they were found in locations where normally should not be observed, especially Retzius lines, Owen's lines, Tomes layer and dentinal tubules disorders were present.

The authors concluded that structural and substructural disorders of the tooth acquired from this boy's cleft palate were found. These disorders are probably connected with the influence of the changed environment in which critical stages of tooth development took place.

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