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Oral Abnormalities in the Saldino-Noonan Syndrome

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Summary. The oral and dental features of a case of the Saldino-Noonan lethal short rib-polydactyly syndrome (SNS) are described. Natal teeth were noted. The anterior maxillary and mandibular fornices and the central labial frenula were absent. The tongue appeared larger than normal and lacked the sulcus terminalis and the vallate and foliate papillae. The tooth anlagen were abnormal. Microscopic studies revealed small tooth buds, in which hard tissue formation was more advanced than gestational age; abnormalities were noted primarily in the most recently formed dental tissue, indicating that the biochemical defect responsible for this disorder had acted abnormally on dentinogenesis mainly shortly prior to birth. Studies of oral and tooth development should be important to better understanding the abnormal function of the chondrodystrophy genes.

Key words: Saldino-Noonan syndrome – Short-rib-polydactyly syndrome – Natal teeth – Oral abnormalities

The Second International Nomenclature of Constitutional Diseases of Bone lists at least 22 different skeletal dysplasias recognizable in the neonatal period due to defects of growth of tubular bones and/or spine (McKusick 1978). Among these disorders is a group of syndromes characterized, in addition, by a very small thoracic cage and by polydactyly. This group of short rib-polydactyly (SRP) syndromes includes asphyxiating thoracic dysplasia (Jeune syndrome), chondroectodermal dysplasia (Ellis-van Creveld syndrome), the Majewski syndrome and the Saldino-Noonan syndrome (Krepler et al. 1976).

We report the oral manifestations in an infant with the Saldino-Noonan syndrome (SNS).

Case Report

A severely dwarfed male infant was prematurely born following 28 weeks of postmenstrual gestation to a 27 year old, gravida 3, para 1 white female and a 35 year old U.S. Black. The

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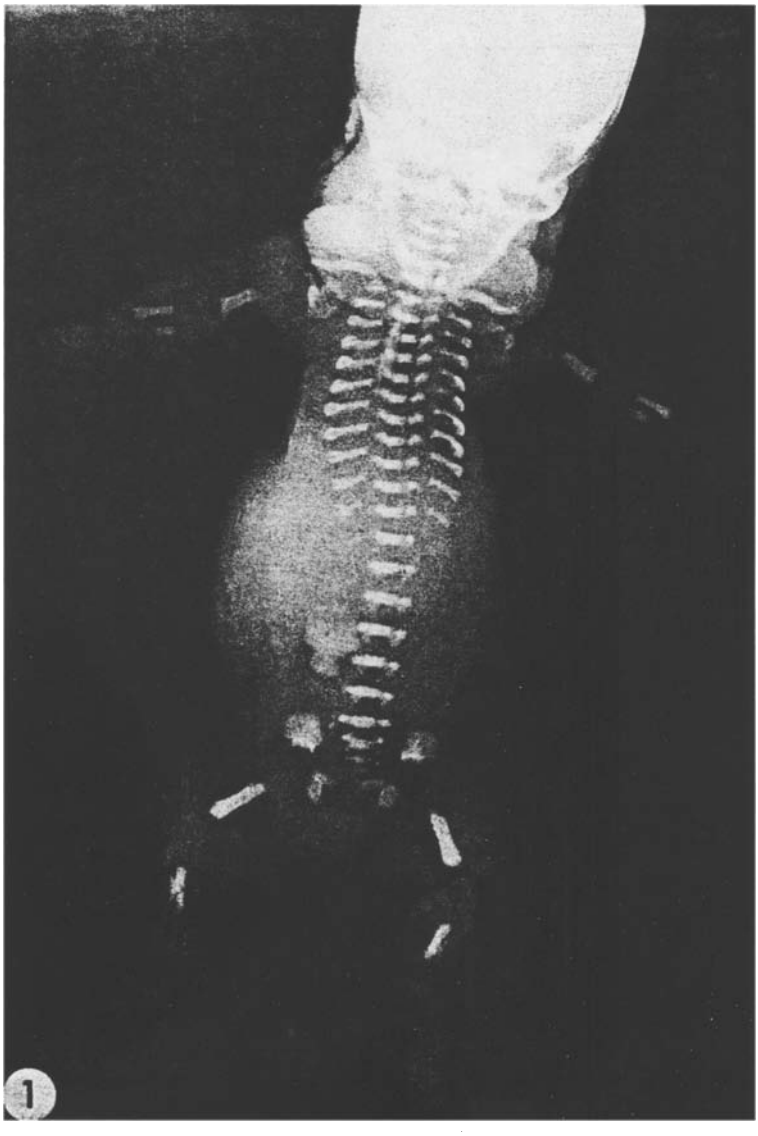


Fig. 1. Post mortem whole body radiograph of male fetus of 28 weeks post-menstrual gestation age with Saldino-Noonan syndrome (SNS). Note severely constricted thorax with short ribs, and small limbs. The bones of the hands and feet are hypomineralized

pregnancy had been unremarkable except for a history of daily use of 5 mg of levomepromazine for the past 5 years. The drug had also been taken during her other pregnancies. In addition, she had taken 5 mg of diazepam at irregular intervals although it was unknown whether the drug had been taken during the present pregnancy. The infant was liveborn, but had no spontaneous respiration and died shortly after birth.

The mother's first pregnancy, 10 years previously, ended in a spontaneous miscarriage in the second month of gestation. Her second pregnancy resulted in the birth of a normal female.

The third pregnancy, the first with the current husband, ended in the delivery of a stillborn male child who was severely dwarfed with the same condition as the infant reported here. A full report of both cases is published elsewhere (Boman et al. In press).

The infant had a hydropic appearance, weighed 1,180 g (normal 1,205 g) (Documenta Geigy 1975), had a crown-heel length of 32 cm (normal 37.8 cm) (Documenta Geigy 1975), a crown-rump-length (CRL) of 25.4 cm (normal 23 cm) (Hamilton et al. 1959), and a head circumference of 27 cm (normal 26.7 cm) (Documenta Geigy 1975). The limbs were disproportionately short, and there was postaxial heptasyndactyly of both hands and hexasyndactyly of both feet. The thorax was short and extremely narrow, measuring only 18 cm in circumference. The abdomen was bulging. Extensive genitourinary malformations included ambiguous external genitalia, aplasia of the prostate and urethra and large cystic kidneys with megaloureters. Testes were present intra-abdominally. The infant also had severely hypoplastic lungs. The heart weighed 9 g and exhibited complex malformations involving large atrial and ventricular septal defects and hypoplasia of the left atrium and ventricle. The pulmonary trunk was transposed to the left, the ductus arteriosus was open, and the ascending aorta appeared normal. The laryngeal lumen was extremely narrow, and adrenal medullary aplasia was found.

Radiologic examination of the skeleton revealed findings characteristic of the Saldino-Noonan syndrome (Spranger and Grimm 1974) (Fig. 1). The ribs were short and horizontal, the pelvis abnormal with spiculae on the ilia but with clear mineralization of the sacrum, pubic and ischeal bone. The long tubular bones were severely shortened with marked metaphyseal irregularities, especially in the legs, were the fibula was shorter than the tibia. Only very small ossification centers could be seen in the hamate, talus and calcaneus. In each hand, an ossification center was visualized in four metacarpals but in none of the metatarsals or phalanges. Despite the deficient ossification, the ossification centers in the bones of the hands and feet were dense and sharply outlined, giving an overall impression of increased radiopacity.

Pulmonary fibroblasts from both babies were grown and karyotyped following trypsinization and studied with conventional techniques and G-banding, revealing a normal masculine chromosome pattern. Karyotyping of both parents with Giemsa banding revealed normal chromosomes.

Material and Methods

The oral cavity was investigated macroscopically in situ in thawed condition, and the jaws were radiographed. A plaster cast was prepared of the facies, which was thereafter removed en bloc with the mandible and maxilla including the temporo-mandibular joint and the entire tongue. Plaster casts were prepared of the opened oral cavity and several dimensions measured. The maxilla and mandible were dissected out, fixed and decalcified. The maxilla was sectioned into 16 and the mandible into 18 blocks, transversely to the alveolar ridge, subjected to routine histologic procedures (Drury and Wallington 1976) and serially cut at 5 μm. The sections were stained with hematoxylin and eosin and with Mallory's connective tissue stain and subjected to light microscopic investigation. The maximal tooth length, measured from the most incisal point of the cusp tips of the highest cusp to the most apical point of hard tissue, the maximal tooth width and the distance from the mucous membrane surface to the nearest point on the tooth germ were measured using a micrometer scale at 32 × magnification.

Results

A philtrum was lacking. The intercommisural width of the lips and the external parts of the lips were normal. There were no labial pits. The anterior maxillary and mandibular vestibular fornices and frenula were absent, so that the lips were attached directly to the alveolar process for approximately 12 mm (Figs. 2, 3). The mucous membrane of the lips was corrugated with multiple shallow sagittal folds. In the maxilla, the fornix-devoid area terminated distally in bilateral well-demarcated frenula.

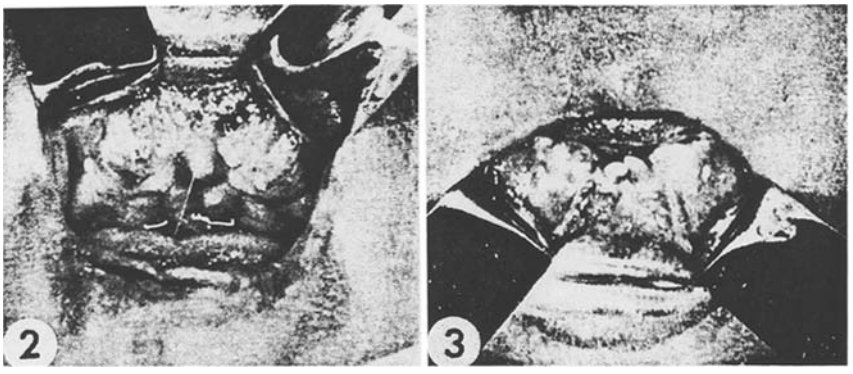


Fig. 2. Anterior maxilla of the fetus with SNS. Observe missing vestibular fornix, missing central frenulum and corrugated vestibular mucous membrane

Fig. 3. Anterior mandible of the affected fetus. Observe two erupted central incisors, absent vestibular fornix and corrugated vestibular mucous membrane

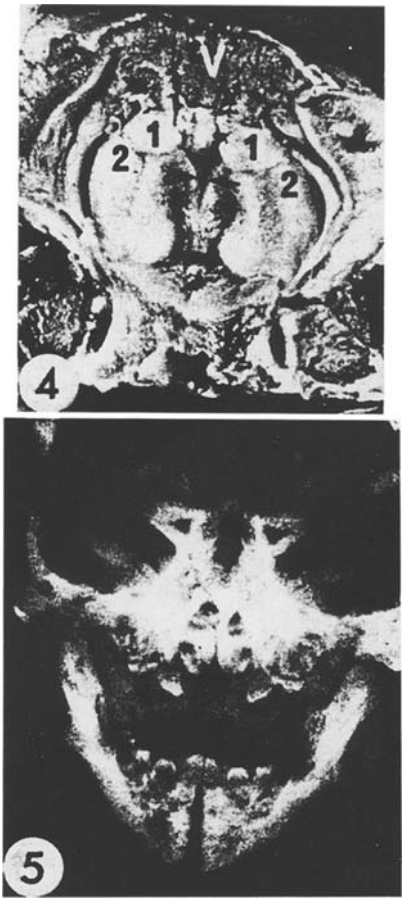


Fig. 4. Palatal view of dissected maxilla reveals anterior missing vestibular fornix, corrugated vestibular mucous membrane and bilateral grooves crossing the alveolar process and forming segments for the lateral incisors (*1*), canines and molars (*2*). *V* = vestibular area. Arrows indicate central sulcus running caudally from the incisive papilla

Fig. 5. Roentgenogram of facial skeleton. Anterior view.
The following teeth may be identified:

	54	53			63	64	
85	84	83	81	71	73	74	75

The mandibular symphysis is open

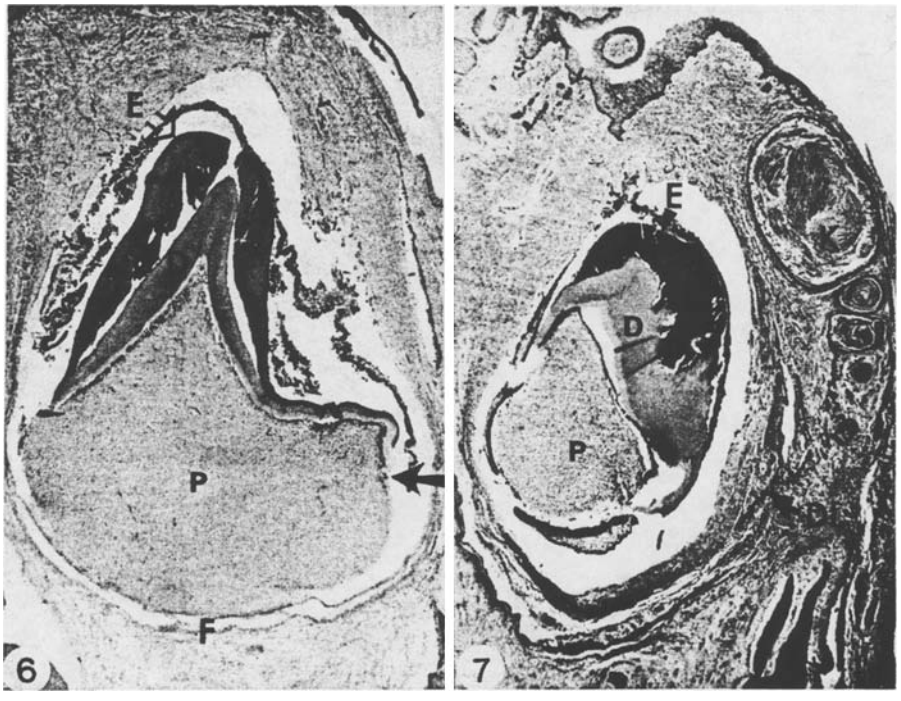


Fig. 6. Microphotograph of mandibular decidous canine germ with broad apical area. Considerable amounts of acid insoluble enamel (*E*) and regular dentin (*D*) are seen. Black arrow points at irregular apical dentin. *F*, dental follicle; *P*, dental papilla. H & E. Orig. mag. ×8

Fig. 7. Microphotograph of mandibular first decidous molar germ. Highly varying amounts of strongly basophilic acid insoluble enamel (*E*) are observed. *K*, dental lamina cyst; *D*, dentin; *P*, dental papilla; *DL*, remnants of the dental lamina. H & F. Orig. mag. ×8

The *maxilla* measured maximally 22 mm in the transverse and 19 mm in the sagittal plane. Two central incisors just penetrated the oral mucosa (Fig. 4). On the maxillary-premaxillary border, bilateral grooves transversed the alveolar process and proceeded anteriorly and posteriorly in the palate. Thus, two segments were noted in each jaw half, one segment corresponding to the area in which the lateral incisor was developing, and the other segment to the area of developing canine and molar germs. The palate was closed and flat. The prominent incisive papilla was separated from the surrounding tissue by bilateral sulci extending over the alveolar process and merging into a single 5 mm long central sulcus running dorsally.

The distance from the most anterior point of the *mandibular* symphysis to the most cranial point on the convex surface of the condyle was 36 mm. In the mandible two highly mobile, peg-shaped incisors, the clinical crowns of which were 1.8 mm and 1.5 mm long and 1.0 and 0.7 mm in mesiodistal direction, respectively, were observed (Fig. 3). Lateral to each central incisor was a prominence, approximately 3.7 × 4.0 mm and separated from the sur-

Table 1. Maximal length and bucco-lingual width of teeth and tooth germs in 28 weeks old fetus with short-ribpolydactyly syndrome, type Saldino-Noonan

Mean values of right and left teeth

Tooth/tooth germ		Max. width[a] in mm	Max length[b] in mm	mm below surface
Maxillary				
Deciduous	first incisor	1.4	2.2	Erupted
	second incisor	0.8	[c]	2.0
	canine	3.0	2.5	1.5
	first molar	2.5	2.8	1.2
	second molar	3.5	4.2	1.5
Permanent	first molar	2.1	1.7	1.5
Mandibular				
Deciduous	first incisor	1.0	1.6	Erupted
	second incisor	1.2	2.0	1.0
	canine	2.3	3.0	1.1
	first molar	2.2	2.1	1.9
	second molar	2.2	2.3	1.8
Permanent	first molar	1.6	2.4	1.8

[a] The maximal width was defined as the largest transversal distance of the tooth
[b] The maximal length was defined as the largest longitudinal distance of the tooth, from the incisal edge/highest cusp to the most apical hard tissue matrix
[c] Oblique sections

rounding tissue by a narrow groove. On radiographs, each of these two promiences contained a developing deciduous lateral incisor and canine.

Further caudally, the alveolar process and mucous membrane were normal. The tongue, maximally 19 mm in the transverse plane and maximally 35 mm in the sagittal plane, was larger than normal, filling the entire oral cavity so that its base abutted into the dorsal pharyngeal wall. The anterior 1/3 of the tongue had a central sagittal sulcus, but no terminal sulcus could be traced. The lingual frenum was short and thick. The tongue had filiform and fungiform papillae, but lacked foliate and vallate papillae.

The normally radiopaque jaws contained shell-like slightly radiopaque developing teeth (Fig. 5). The following teeth could be identified:

	54	53			63	64	
85	84	83	81	71	73	74	75

Structures compatible with the maxillary deciduous second molars could be discerned on the original roentgenogram. The mandibular symphysis was open.

On light microscopic investigation, all deciduous and the four first permanent molars could be identified. No succedaneous teeth were observed. All teeth were malformed. The incisors were cone-shaped, while the canines widened dramatically towards the cervical part (Fig. 7). The deciduous and permanent molars had a narrow occlusal region, increasing markedly in width cervically and were shorter than normal in occluso-apical direction

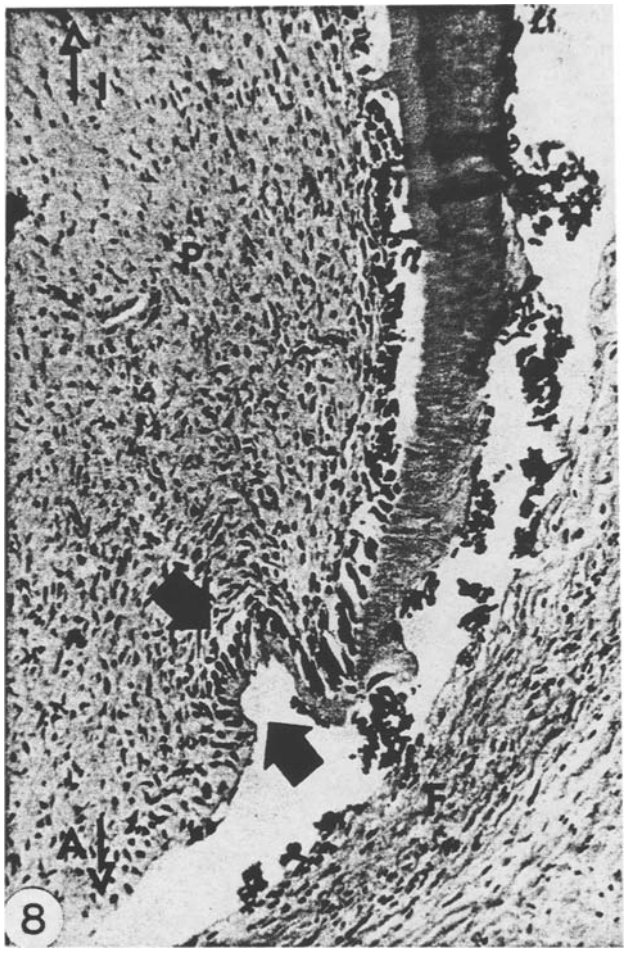


Fig. 8. Microphotograph of apical area in maxillary deciduous canine germ. Observe bulging irregular dentinoid and disarrayed odontoblasts (*arrows*). *P*, dental papilla; *F*, dental follicle; *A*, apically; *I*, incisally. H & E. Orig. mag. × 50

(Fig. 7). The maximal tooth length, including the enamel organ when present, ranged from 1.6 mm to 4.2 mm, the maximal width from 0.8 mm to 3.5 mm (Table 1). The distance from the surface of the oral mucous membrane to the unerupted teeth was from 1.0 to 2.0 mm. The erupted mandibular central incisors, scarcely attached to the mucous membrane, were only 1.6 mm long and lacked roots and Hertwig's epithelial root sheath. The unerupted part of these incisors was harboured in a shallow soft tissue cavity laterally lined by parakeratinized squamous epithelium, from which small bud-like or trabecular epithelial proliferations extended into the soft tissue. All unerupted teeth were partially surrounded by their developmental crypts.

A dental lamina of the permanent teeth was usually present, and the continuity of this lamina of the first permanent molars was broken.

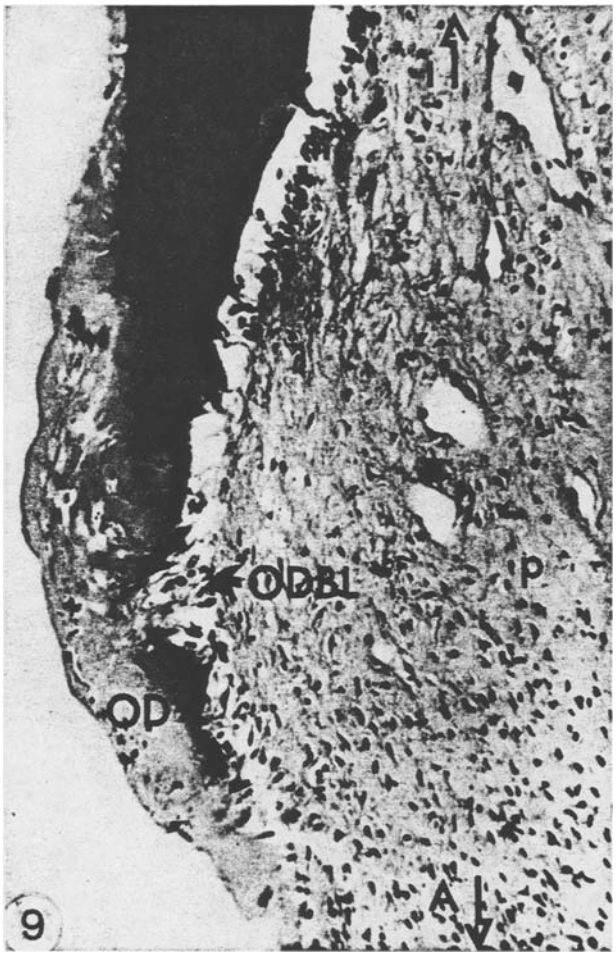
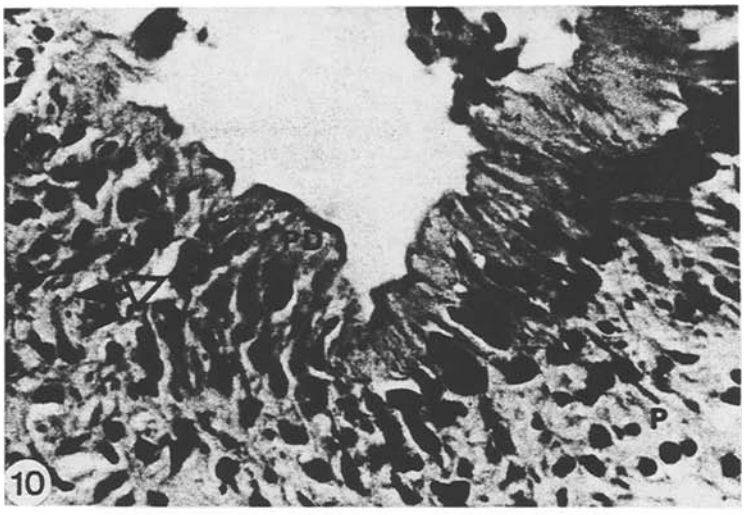


Fig. 9. Microphotograph of apical area of erupted mandibular first deciduous incisor. Irregular dentin partly as osteodentin (*OD*) with cellular inclusions and disarrayed odontoblasts (*ODBL*) are observed. *P*, dental papilla; *A*, apically; *I*, incisally. H & E. Orig. mag. × 50

One or more dental lamina cysts were observed in the connective tissue adjacent to most teeth (Fig. 7).

The dental papilla of the central incisors was disrupted from the subjacent connective tissue; no pulp-delineating membrane was present, while this structure was found apically in the canines, deciduous and permanent molars (Figs. 6, 7).

In the incisors and canines only the crown had formed. The dentin tubules were regular and of normal width (2.5–5 μm) in the incisal area, especially near the pulp. Apically, however, irregularly corrugated dentinoid with cellular inclusions, and few, highly irregular dentin tubules, some as wide as 10 μm, constituted the entire tooth wall (Figs. 8, 9).



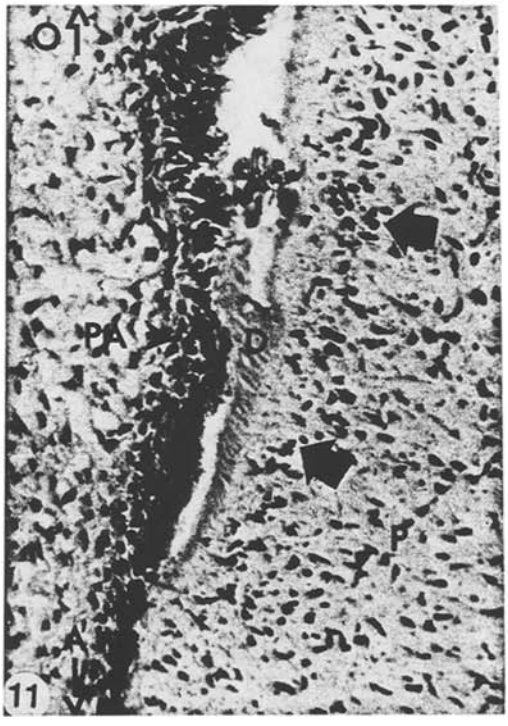


Fig. 10. Microphotograph of occlusal region of deciduous mandibular first molar anlage demonstrates disarrayed odontoblansts (*arrow*) and highly irregular predentin (*PD*) with bulging amelodentinal junction. *P*, dental papilla. H & E. Orig. mag. × 200

Fig. 11. Microphotograph of occlusal region of mandibular first permanent molar demonstrates small amounts of irregular predentin (*D*). Arrows point at small, dark, disarrayed odontoblasts. *PA*, preameloblasts; *P*, dental papilla; *O*, occlusally; *A*, apically. H & E. Orig. mag. × 50

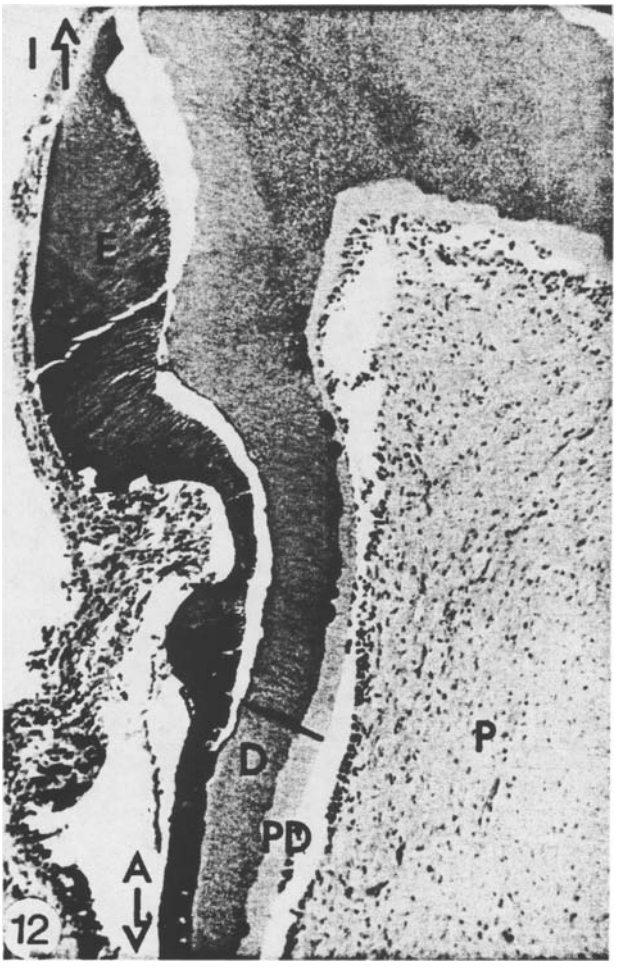


Fig. 12. Microphotograph of incisal region of mandibular deciduous second incisor reveals hypoplastic, strongly basophilic acid insoluble enamel (*E*), irregular amelodentinal border, irregular dentin (*D*) and predentin (*PD*) zone of varying thickness.*P*, dental papilla; *I*, incisally; *A*, apically. H & E. Orig. mag. × 32

Osteodentin with irregular areas of mineralization was occasionally found subjacent to the amelodentinal border. The first formed predentin and dentin at the cusp tips of the deciduous molars were usually regular, while the canals of the dentin matrix at the central developmental groove were irregular in direction and width (2.5–8 μm), with cellular inclusions and poor, if any, calcification (osteodentinoid) (Fig. 10). Apically, irregular folded strands of osteodentin, as observed in incisors and canines, extended obliquely or horizontally from the more occlusal part of the teeth. A thin band of diffuse, eosinophilic predentin with irregular canals and minor signs of mineralization only in the cusp/occlusal area was noted in the permanent molars (Fig. 11). In central and apical areas of all teeth the predentin zone width varied, but generally appeared relatively broad (0.5–0.7 mm thick).

Fig. 13. Microphotograph of lateral aspect (lateral section) of same tooth as in Fig. 6 demonstrates highly dysplastic apical dentin (*D*) with lacunae harbouring closely packed cell remnants of odontogenic epithelium (*OE*). *I*, incisally; *A*, apically, H & E. Orig. mag. × 32

The dentinenamel junction was very irregular in all teeth (Fig. 7).

The amount of acid-insoluble enamel varied in thickness from one region to another in all teeth except the permanent molars (Fig. 12). The enamel prisms varied in width and course. A strongly basophilic material devoid of prisms and with occasional cellular elements was also found. In some areas devoid of enamel matrix, cells of the enamel organ abutted directly on the dentin. In some incisors apical dentin invaginations contained closely packed cells of reduced amelogenic epithelium and some acid insoluble enamel (Fig. 13).

Cellular features were not studied in detail, since autolytic changes had taken place. However, the odontoblasts often appeared disarrayed, sometimes crowded, atrophic, strongly eosinophilic, and polymorphous. The ameloblasts were regularly arranged, but cellular details could not be reliably visualized.

The mandibular and maxillary bone was immature, devoid of lamellae and resting lines, with large irregular osteocyte lacunae and basophilic staining properties. The immature bone might be surrounded by small amounts of mature bone. Although osteoblasts were occasionally observed, autolytic changes prevented the study of cellular details.

Discussion

In the group of short-rib-polydactyly sondromes, shortening of the ribs is most severe in the Majewski and Saldino-Noonan syndrome (SNS), which are invariably fatal in the neonatal period. These two conditions are distinguished from each other not only by their characteristic radiologic appearance, but also by their respective clinical and pathologic features (Krepler et al. 1976; Spranger and Grimm 1974). It is possible that the SNS is itself heterogeneous (McKusick 1978) and that other lethal short-rib-polydactyly syndromes may exist (Piepkorn et al. 1978).

The clinical, radiologic and genetic features of the present case were compatible with those described for the SNS (Saldino and Noonan 1972; Spranger and Grimm 1974; Krepler et al. 1976; Boman et al. in press). Extensive abnormalities in the oral cavity were noted: missing vestibular fornices, extra vestibular frenula, absent philtrum, a large tongue devoid of the sulcus terminalis and vallate papillae, natal teeth (all first deciduous incisors), premature hard tissue formation in first permanent molars, hypoplastic and hypocalcified enamel, irregular amelo-dentinal junction, and hypoplastic and hypocalcified dentin.

A missing vestibular fornix as observed in our patient with the SNS is considered a cardinal sign in the Ellis-van Creveld syndrome (McKusick et al. 1964; Gorlin et al. 1976), in which extra vestibular frenula have also been described (McKusick et al. 1964; Spranger and Grimm 1974). Supernumerary frenula were also present in our case. In the lower lip, the lack of an anterior fornix may be due to failure of separation of the superficial from the deeper portion of the mandibular process. The area corresponds to the region which develops from the caudal end of the naso-frontal process (Hamilton et al. 1959), while the mucobuccal fold in the lateral regions develops from the maxillary process (Hamilton et al. 1959). Since the philtrum develops by a "heaping up" of maxillary mesoderm on either side of the midline (Hamilton et al. 1959), the lack of a philtrum probably reflects a mesodermal defect.

Although exact measurements of the jaws have not previously been reported in the SNS, the maxilla and mandible have been described as hypoplastic (Saldino and Noonan 1972; Krepler et al. 1976). In a normal 7 month fetus the CRL is approximately 23 cm (Hamilton et al. 1959), which corresponds to an occipito-frontal diameter of approximately 83 mm and a pogonion-condylon length of 3.00 cm as extrapolated from reference fetal radiographic material (Kvinnsland 1968). A similar investigation reported a pogonion-condylon length of 3.5 cm in 28 week old normal fetuses (Luke 1976). As in the present case the symphysis-codyle length was measured

to be 3.64 cm directly on the macroscopic specimen, the figures are not comparable, but they indicate a normal mandibular length.

In a 7 month old normal fetus, 5 segments each corresponding to one of the deciduous tooth germs are present in each jaw half (West 1925). Since central incisors were erupted in the present case, the corresponding notched segment had regressed. However, only the lateral incisor and canine/molar segments were observed, while in a normal 7 months old fetus the more caudal tooth segments are also present. In the Ellis-van Creveld syndrome the serrated appearence of the alveolar ridges may be result of persistence of the tooth segments normally present from 3 to 7 months in utero (Gorlin et al. 1976). No conclusion can be drawn as to the persistence of jaw segements being a part of the SNS at term, as the present fetus was 7 months old only.

A large tongue has also been described in a full term female infant with the SNS (Spranger and Grimm 1974). Missing sulcus terminalis and vallate papillae, normally the first lingual papillae to appear together with the foliate at about 50 days in utero (Hamilton et al. 1959), have not previously been reported in the SNS. Neither has the absence of foliate papillae, which, however, are inconstantly present in man (Orban 1980).

Natal teeth, i.e., teeth present at birth, occur with a frequency of 1 per 2,000–14,000 births (Hals 1957; Bodenhoff 1959; Bodenhoff and Gorlin 1963) and are noted predominantly in the mandibular incisor region. They have also been descibed in pachyonychia congenita, oculomandibulodyscephaly (Hallermann-Streiff syndrome), in cyclopia, and in the Ellis-van Creveld syndrome (McKusick et al. 1964; Biggerstaff 1968; Gorlin et al. 1976; Anneroth et al. 1978). A single, centrally placed mandibular incisor was erupted at birth in one case of the Majewski syndrome (Bidot-López et al. 1978), and two maxillary incisors "seemed to be erupted" in a male fetus of 26 weeks intrauterine age with the SNS (le Marec et al. 1973).

Details of the oral findings in that case were not published.

The present case of the SNS is the second reported with natal teeth; the mandibular first deciduous incisors had erupted, and the maxillary first incisors just penetrated the mucosa. As the erupted maxillary first incisors could not be seen roentgenographically, they must have been hypomineralized.

The etiology of natal teeth is unknown, but their occurrence may be due to superficial position of the tooth germ and unknown genetic factors (Hals 1957; Spouge and Feasby 1966). The condition predominantly affects mandibular incisors (Hals 1957; Bodenhoff 1959; Bodenhoff and Gorlin 1963). Since the teeth are located in soft tissue, they likely meet little resistance to eruption. The irregular highly cellular basal osteodentin which likely formed rapidly, may have contributed to early eruption (Hals 1957). Hals (1957) indicated that the osteodentin might partly result from an abnormal tooth motility in natal teeth, which are devoid of bone attachment, a view supported by Anneroth et al. (1978), who focused attention on disturbing movements due to lip and tongue pressure. In the present case, however, irregular masses of osteodentin were also observed in the uner-

upted canines and deciduous molars, indicating a more general deleterious effect on the fetus shortly prior to death. This assumption is supported by the presence of recently formed irregular dentin on the occlusal surfaces of deciduous molars and on the cusps of the permanent ones.

Most teeth were malformed, and the erupted incisors were devoid of roots and attached to the mucous membrane only, similar to the findings in most reports on natal teeth (Hals 1957; Bodenhoff 1959; Anneroth et al. 1978). Generally, the enamel of natal teeth displays normal prism structure and mineralization (Gardner and Dort 1979), while breaks, folding and cracking may appear (Hals 1957; Anneroth et al. 1978). The strongly basophilic, amorphous enamel and focal enamel deposits observed here resemble the findings in epidermolysis bullosa dystrophica dysplastica et lethalis and in odontomas (Arwill et al. 1965; Gardner and Dort 1979). The hypolastic enamel in our case may be due to abnormalities in odontoblast induction on ameloblasts as the major defect may be mesodermal.

Normally 1–4 μm (Orban 1980), the dentin tubule width presently varied between 2.5 μm and 10 μm, while in a larger material of neonatal teeth the values were 20–30 μm (Anneroth et al. 1978).

While pursuing an unusually straight course in most natal teeth, (Hals 1957; Bodenhoff 1959) the amelodentinal junction in the present case appeared highly irregular.

Tooth bud diameters may be used to calculate the dental age of a fetus since they are related to CRL and thus to fetal age (Kraus and Jordan 1965; Luke 1976; Garn et al. 1979). The buccolingual diameter of the maxillary second deciduous molar was 3.5 mm in the present case, corresponding to a mesiodistal diameter of 3.3 mm and a fetal age of approximately 19 weeks (CRL 17.3 cm) (Kraus and Jordan 1965). Similarly, the present buccolingual diameter of the mandibular first deciduous molar in our specimen was 2.2 mm, corresponding to a mesiodistal diameter of 3.1 mm and a fetal age of approximately 17 weeks (CRL 13.6 cm). Although, because of methodologic and race differences, the present data are not directly comparable with published normal data (Kraus and Jordan 1965), it seems justified to conclude that the molar bud size of the present 28 weeks old fetus corresponded to that of a 17–19 weeks old.

In all tooth anlagen the connection between the dental lamina and the tooth germ had been interrupted, and the epithelial remnants were more extensively resorbed in the posterior regions than in the anterior regions of the jaws. Resorption normally occurs in the late cap stage (Mjør and Pindborg 1973), while hard tissue production commences considerably later, in the advanced bell stage (Orban 1980; Mjør and Pindborg 1973). The tooth anlage of the first permanent molar normally loses its connection with the dental lamina at 7 months in utero (Krogh-Paulsen 1951), so the present findings concur with what could be expected. However, the formation of dentin and enamel matrices in maxillary and mandibular first permanent molars normally starts only at birth or shortly before (Orban 1980). Since traces of uncalcified dentin matrix were found in these teeth of the 28 week old fetus with the SNS, it may be concluded that hard tissue produc-

tion here occurred at least 2 months prematurely in the first permanent molars. The cusps of the deciduous second molars were united in our case; thus development of these teeth was also advanced for chronologic age, since the cusps of these teeth are normally still isolated at birth (Orban 1980).

Since the dentin which was deposited early in development appeared well differentiated, it must either have been formed during a stage of fetal development relatively free from injurious insults, or the early dentin may not be susceptible to the metabolic error of the syndrome. The dentin deposited later had markedly irregular matrix and mineralization present in most teeth, similar to that observed in most natal teeth (Hals 1957; Bodenhoff 1959; Anneroth et al. 1978).

No previous reports describe the histologic pattern of the intermembraneous maxillary and mandibular bone in the SNS. Immature bone, as seen in the present case, normally occurs in embryonic life. In endochondral bones (humerus, femur, sternum) of the same case, however, lack of chondrocyte columnization and faulty chondroblast maturation were observed. Trabeculae of new bone extended deeply into the cartilage. The spongious bone appeared coarse and ossification centers were narrow (Boman et al., in press). Similar changes have been reported in other cases of SNS (le Marec et al. 1973; Krepler et al. 1976).

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