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PYCNODYSOSTOSIS

(dysostosis petrosans)

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Pycnodysostosis is a term coined by Marouteaux in 1962 to describe a disorder characterized by open cranial suture, generalized bone sclerosis and fragility, shortening of the terminal phalanges, etc. This disease complex was reported as an atypical case of dysostosis cleidocranialis or osteopetrosis until 1954, when this entity was first differentiated from these two diseases by Aoike and named dysostosis petrosans.

The purpose of the writer is to report two cases of pycnodysostosis (68-year-old male and 19-year-old female) and review forty-eight cases from foreign and Japanese literature. These meet the criteria for pycnodysostosis, although the diagnosis and the title of the reports varied according to the authors.

Case 1

This patient was a 68-year-old male.

Family history. Two of his five brothers had a prominent sagittal groove in the forehead. All of his three daughters were small and had similar shaped heads and short stubby fingers. The roentgenogram of the pelvis of his first daughter taken before the cesarean section revealed segmentation of the fourth and the fifth lumbar spinous processes. The large major fontanelle of the baby was noted by a pediatrician. A repeated attempt to persuade his family to come to the X-ray department failed.

History. Nothing is known about his birth history. He had fractured his right elbow at the age of twenty-five and his right fifth metatarsal three years ago. He had progressive difficulty in hearing for ten years. He gradually lost his teeth after the age of fifty.

Clinical findings. The patient was 148 centimeters tall. The shoulders were narrow and drooping. The skull was enlarged with frontal bossing (Figure 1). The

Case 2 was presented orally by Matsunaga, M. and Ichikawa, M. at the Eleventh East Japan Orthopaedic Meeting in 1962.

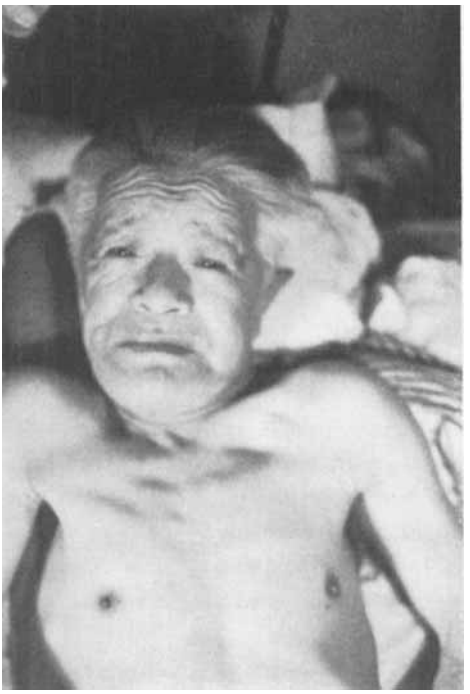


Figure 1: Case 1. The head was enlarged with frontal bossing. The base of the nose was depressed and the distance between the eyes was unusually widened. The shoulders were narrow and drooping.

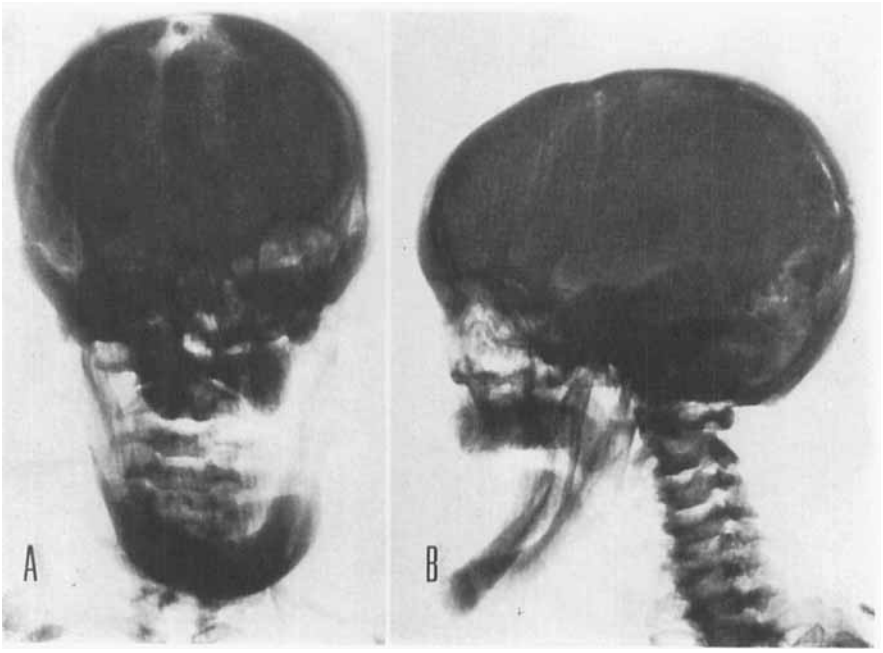
biparietal diameter was increased. The base of the nose was depressed and the distance between the eyes was unusually widened. There were no teeth and a high arched palate was seen. There was no serious disproportion between the trunk and extremities except for the hands and feet. The lateral two-thirds of the right clavicle was replaced by a fibrous cord. Both shoulders could be easily approximated. His fingers and toes were short and stubby.

Roentgenographic findings. The skull was broad with a cephalic index of eighty-two. The cranial sutures were separated (Figure 2). There was wormian bone formation along lambdoibal suture. Sclerosis involved the base of the skull. The pituitary fossa was small and deep. The tip of the clinoid process was curved forwards and thickened. The nasal bone and the paranasal sinus were hypoplastic. The flat angle of the mandible was the outstanding feature. There were no teeth.

The lateral two-thirds of the right clavicle was completely absent and the remaining part was hypoplastic (Figure 3). Slight hypoplasia of the acromial end of the left clavicle was present. The residual acromion growth plate was seen on the left side.

A varus deformity of the right elbow was noted along with left radius overgrowth. The metaphyseal part of the metacarpals and the proximal phalanges were abnormally broad. The middle phalanges were short and wide. The terminal phalanges were short and tapered (Figure 4).

The superior and inferior end-plates of the vertebrae were sclerotic and irregular.



Figures 2-A and 2-B: Anteroposterior and lateral roentgenograms of the skull. Case 1. The skull was broad with a cephalic index of eighty-two. The cranial sutures were separated. There was wormian bone formation along lambdoidal suture. Sclerosis involved the base of the skull and the mandible. The paranasal sinus was hypoplastic. The flat angle of the mandible was noted. No teeth were seen.

The pelvis showed generalized increased density and the iliac components were small (Figure 5).

Coxa valga was noted and the distal femoral metaphysis was broad bilaterally. Lateral ligamentous instability to thirty degrees was present in the left knee. The first metatarsal neck and diaphysis were broad. The phalanges were broad and short. A healed fracture was seen in the middle of the fifth metatarsal where the diaphysis was thickened (Figure 6).

Laboratory results were within normal limits.

Biopsy. The remaining portion of the right clavicle was connected to the acromion with a fibrous cord. The tip of this part was taken as a specimen. The other specimen was taken from the left ilium. Histologically normal lamellar bone, hematopoietic marrow, and fatty marrow were seen. The bone marrow was partially fibrous. The trabeculae were rather thick. A prominent cement line was noted on the border between the clavicle and the thick fibrous tissue.

Case 2

The patient was a nineteen year old girl.

Family history. Her parents were cousins. There was no history of a patient's disorder among her relatives.

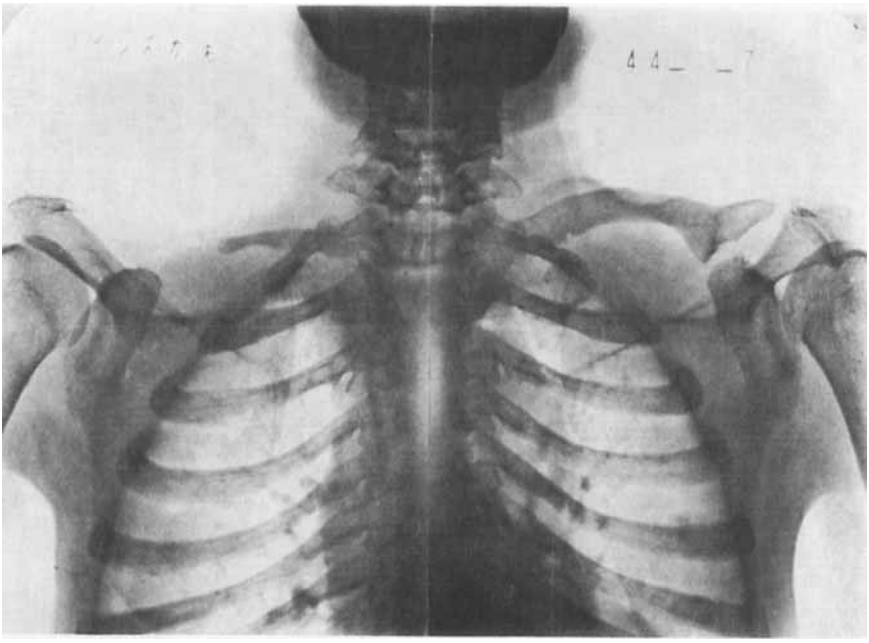


Figure 3: Roentgenogram of upper chest. Case 1. The lateral two thirds of the right clavicle was completely absent and the remaining part was hypoplastic. Slight hypoplasia of the acromial end of the left clavicle was present. The residual acromion growth plate was seen on the left side.

History. She was the product of a normal pregnancy and delivery. She had sustained thirteen fractures of her femurs, tibias, and ribs. A hearing difficulty was noted since childhood.

Clinical findings. The patient was 145 centimeters tall. There was a groove running sagitally from the forehead to the occiput. The hard palate was steep. A double row of teeth was seen (Figure 7). The fingers and toes were short. The terminal phalanges of fingers and toes were bulbous in appearance.

Roentgenographic findings. The skeletal system as a whole showed diffuse osteosclerosis, and the cortex of the tubular bones was considerably thickened.

The coronal and sagittal diameters of the skull were both fifteen centimeters. There was wide separation of the coronal, sagittal and lambdoidal sutures (Figures 8). The mandibular angle was flattened to almost 180 degrees. The alignment of the teeth was irregular. The sella turcica was small. There was mild platybasia without basilar invagination (basilar angle: 155 degrees).

The clavicles were thin with remnants of a residual growth plate at the medial ends. Hypoplasia of the acromial ends was noted.

The superior and inferior portions of the vertebral bodies were sclerotic, and an anterior notch of each body was found (Figure 9). The iliac bones were deformed. There were old subtrochanteric fractures in both femora (Figure 10). A transverse fracture of both mid-tibia in the healing phase was seen with

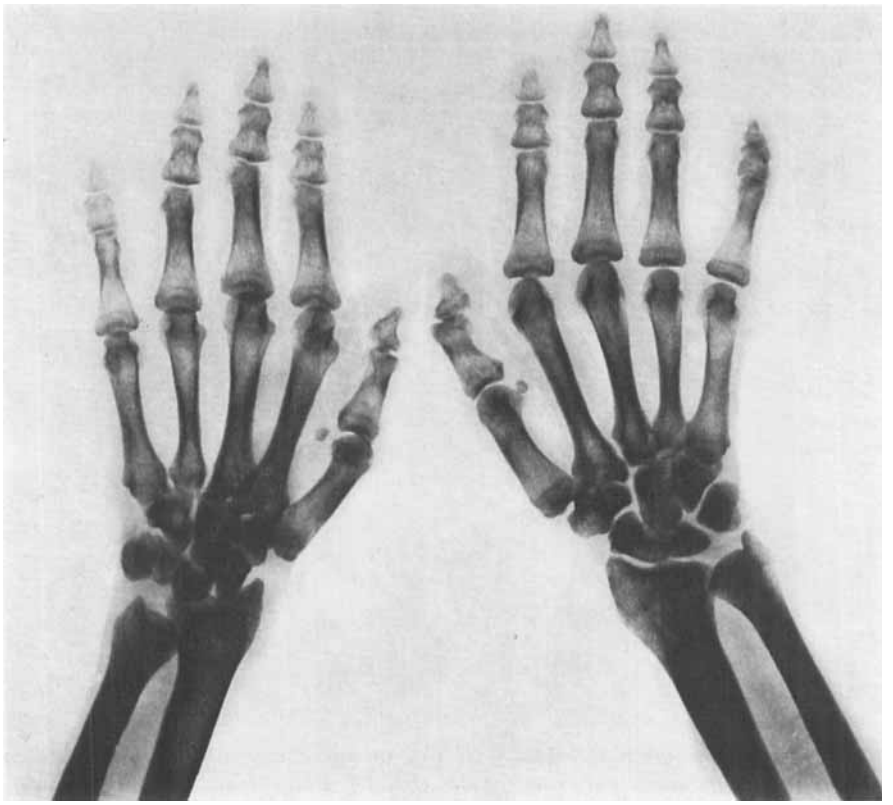


Figure 4: Roentgenogram of hands. Case 1. The terminal phalanges were short and tapered. The middle phalanges were short and wide. The metaphyseal part of the metacarpals and the proximal phalanges were abnormally broad. Over-growth of left radius was noted.

spindle shaped thickening present. The left lower leg was bowed anteriorly (Figure 11). The terminal phalanges of the hands and the feet were extremely short (Figures 12, 13). The metatarsals were also short with broad and deformed bases. The terminal phalanges of hands and feet were short and flat.

Laboratory studies were within normal limits.

Biopsy. A specimen of iliac bone was examined histologically. The thick trabeculae showed mosaic structure and contained coarse fiber bone and persistent mineralized osteochondroid fragments (Figure 14). Bone resorption by osteoclasts and bone deposition by osteoblasts were not extensive but irregular.

DISCUSSION

In 1945 Aoike reported a case of cranial and facial malformation similar to those of cleidocranial dysostosis along with apparent bone

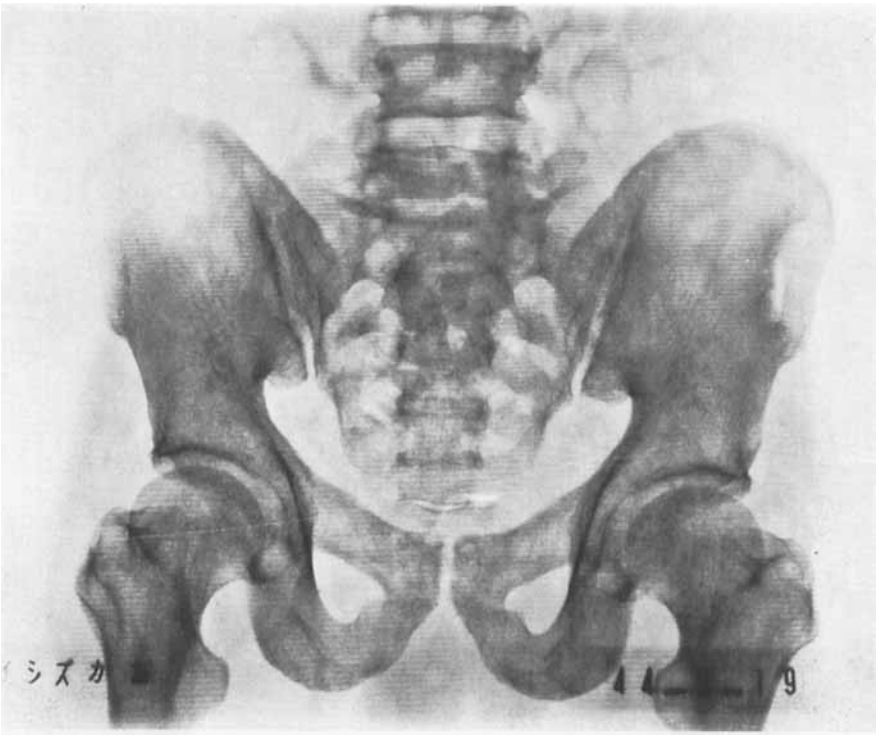


Figure 5: Roentgenogram of pelvis. Case 1. Generalized increased density was seen and the iliac components were small. A defect in left ilium shows the area of biopsy.

sclerosis and fragility. Since then similar cases had been reported by Shima (1949), Seigman (1950), Ito (1952) and Hasue (1954), although their terminology of the diagnosis varied. In 1954 (in Japanese) and in 1958 (in English) Aoike reviewed these cases and separated a new hereditary bone disease characterized by the following features: (1) heredity (2) cranial malformation similar to that of dysostosis cleidocranialis (3) dwarfism (4) maldevelopment of pelvis (5) sclerosis of endplate of vertebral body (6) broad metaphysis (7) dysplasia of distal phalanges (8) bone fragility (9) bone sclerosis (10) histological feature similar to that of osteopetrosis.

In 1962 Marouteaux reported two similar cases which he labeled pycnodysostosis. The characteristic features of pycnodysostosis are (1) heredity (2) open cranial suture and fontanelle (3) hypoplastic mandible (4) frontal and parietal bossing (5) dwarfism (6) hypoplasia of terminal phalanges (7) bone fragility (8) bone density. The

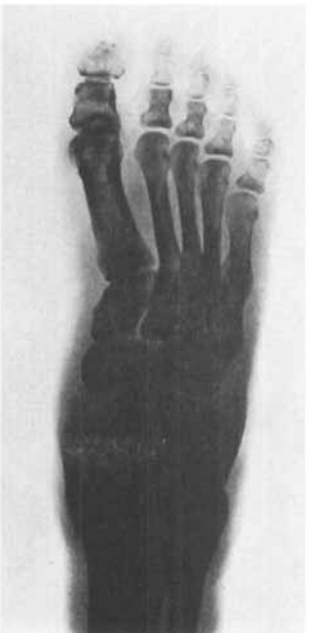


Figure 6: Roentgenogram of the right foot. Case 1. The phalanges were broad and short. A healed fracture was seen in the middle of the fifth metatarsal where the diaphysis was thickened. The first metatarsal neck and diaphysis were broad.

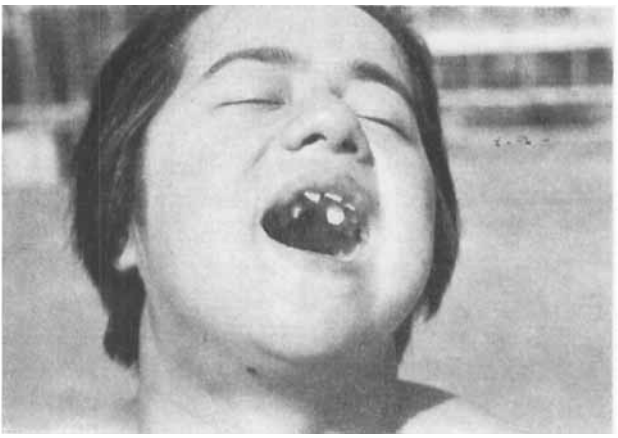
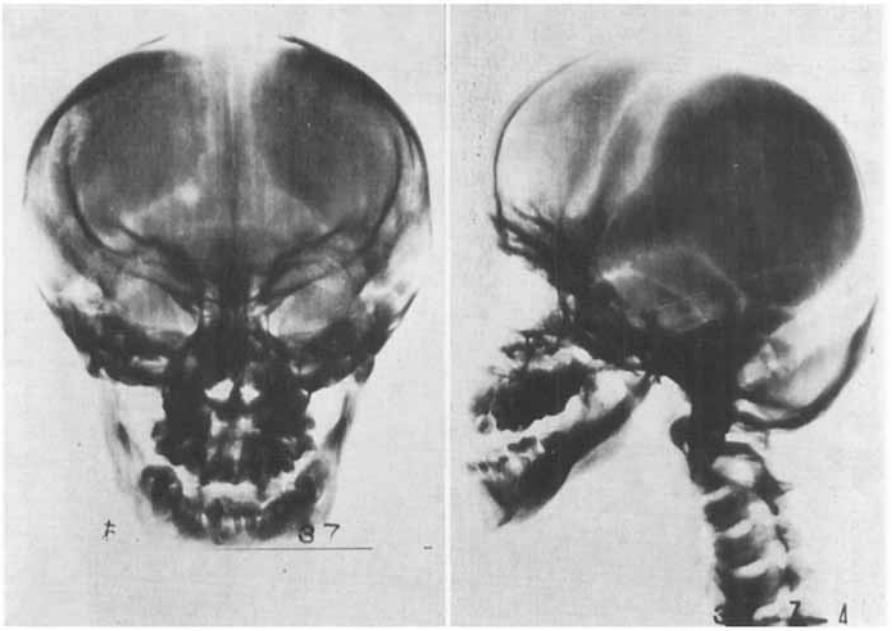


Figure 7: Case 2. The hard palate was steep. A double row of teeth was seen.

author believes that dysostosis petrosans by Aoike (1954) and pycnodysostosis by Marouteaux (1962) are apparently the same entity.

Forty-six cases with open cranial sutures and bone sclerosis were found in the foreign and Japanese literatures (Table 1). The author studied the characteristics common to these forty-six cases and in-



A B

Figures 8-A and 8-B: Anteroposterior and lateral roentgenograms of skull. Case 2. The coronal and sagittal diameters of the skull were both fifteen centimeters. There was wide separation of the coronal, sagittal and lambdoidal sutures. The mandibular angle was flattened to almost 180 degrees. There was mild platybasia.

cluded the two cases discussed. There were twenty males and twenty-eight females. As to age distribution: there were eleven cases under the age of ten, fifteen cases between eleven and twenty, fourteen between twenty-one and thirty, four between thirty-one and forty, and four over forty-one years of age. Twenty of forty-eight cases occurred in brothers and sisters, three were cousins (two of them were a brother and his sister), and two were an uncle and his nephew.

The characteristics of these forty-eight cases were: (1) All patients had a short stature. (2) The cranial sutures were open in all cases. (3) A loss of mandibular angle was seen in thirty-one cases. (4) A defect of the clavicle was found in three cases. This association has not been reported previously. (5) The fingers and the toes were short in forty-six cases and in thirty-eight shortening of the distal phalanx was described. (6) An abnormal alignment of teeth was described in fifteen cases. (7) All cases showed some degree of osteosclerosis. (8)

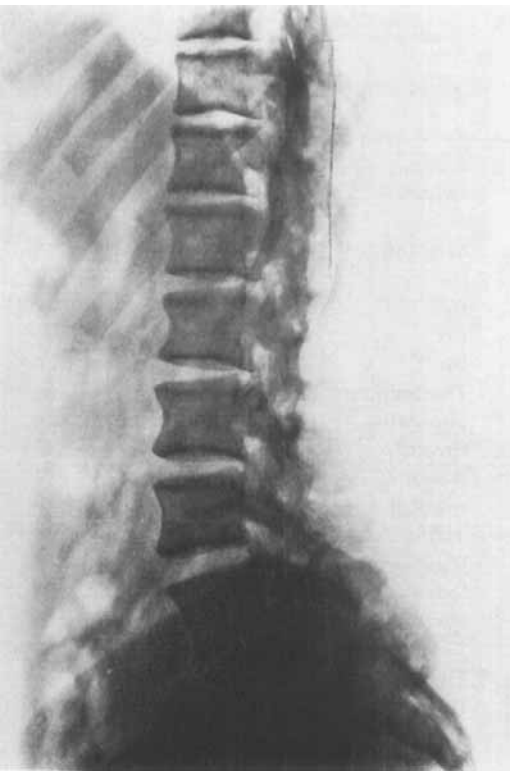


Figure 9: Lateral roentgenogram of spine. Case 2. The superior and inferior portions of the vertebral bodies were sclerotic and an anterior notch of each body was found.

A history of repeated fractures was reported in forty-three cases. In the usual case a transverse fracture occurs in the midshaft and after healing cortical thickness remains, resulting in a spindle-shaped broadening. (9) Broadening of the metaphysis of the tubular bones was found in nine cases. (10) Histological examination was performed in several cases and in four of them the findings were similar to those found in osteopetrosis. (11) The laboratory examination usually showed no abnormality. No hepatosplenomegaly was reported.

As mentioned above, this is a disease complex which combines features of cleidocranial dysostosis and osteopetrosis in various degrees clinically, roentgenographically and histologically.

Soeda (1963) reported a quite interesting case study of a girl whose sister seems to fit the typical case of osteopetrosis. These two diseases have some common features such as generalized osteosclerosis, bone fragility, and broadening of the metaphysis. Fractures usually occur in the diaphysis, and a spindle shaped broadening persists in that area,

Table 1. 48 cases with open cranial

Reported by	Age (Years)	Sex	Dwarfism	Open cranial suture	Obtuse mandibular angle	Defect of clavicle
Aoike	30	♀	+	+		±
Shima	17	♂	+	+		±
Shima	20	♀	+	+		—
Seigman	21	♀	+	+	+	—
Ito	18	♂	+	+		—
Ito	16	♂	+	+		—
Ito	13	♂	+	+		—
Ito	10	♂	+	+		—
Thomsen	21	♀	+	+	+	±
Thomsen	40	♂	+	+	+	±
Hasue	30	♂	+	+		—
Hasue	20	♀	+	+		—
Abboud	8	♀	+	+	+	
Abboud	5	♂	+	+		
Giaccai	28	♂	+	+		±
Sarrouy	12	♂	+	+		
Sarrouy	3	♀	+	+	+	
Thoms	28	♀	+	+	+	±
Thoms	9 mo	♀	+	+	+	±
Palmer	20	♂	+	+	+	
Palmer	20	♂	+	+	+	
Palmer	8	♀	+	+	+	
Palmer	16	♂	+	+	+	
Palmer	13	♂	+	+	+	
Marouteaux	4	♂	+	+	+	—
Marouteaux	1.5	♀	+	+	+	—
Kalliala	26	♀	+	+		±
Andren	21	♀	+	+		—
Andren	21	♀	+	+		±
Shuler	7	♂	+	+	+	±
Shuler	43	♂	+	+	+	±
Soeda	38	♀	+	+	—	+
Sugiura	17	♀	+	+	+	
Sugiura	53	♀	+	+	+	
Elmore	16	♀	+	+	+	±
Dusenberry	22	♀	+	+	+	—
Dusenberry	28	♀	+	+	+	—
Dusenberry	38	♀	+	+	+	—
Koh	6	♂	+	+	+	
Koh	10	♀	+	+	+	
Koh	17	♀	+	+		±
Koh	53	♀	+	+	+	

sutures and bone sclerosis.

Short phalanges	Changes of teeth	Widening of metaphysis	Bone sclerosis	Experience of fracture	Family relation
+	+	+	+	+	
+			+	+	Brother
+	—	+	+	+	Sister
+			+	+	
+	+		+	+	Brother
+	+		+	+	Brother
+	+		+	+	Brother
+	+		+	+	Brother
+		+	+	+	
+			+	+	
+			+	+	Brother
			+	+	Sister
+		+	+	+	Sister
+			+	+	Brother
+	+		+	+	
+		+	+	+	Brother
			+	—	Sister
+			+	+	
+			+	+	
+		+	+	+	
+			+	+	
+			+	+	
+			+	+	
+			+		
+			+	+	Brother
+			+	—	Sister
+	+		+	+	
+	—	+	+	+	Twin
+	—	+	+	+	Twin
+			+	+	Nephew
+			+	+	Uncle
+	—		+	+	
+			+	+	
+			+	+	
+	+		+	+	
+	+		+	+	Sister
+	+		+	+	Sister
+	+		+	+	
+			+		
+			+	+	
+			+	+	
+			+	+	

Table 1.

Reported by	Age (Years)	Sex	Dwarfism	Open cranial suture	Obtuse mandibular angle	Defect of clavicle
Itohara	21	♀	+	+	+	—
Itohara	29	♀	+	+	+	—
Itohara	37	♂	+	+	+	—
Kan	30	♀	+	+	+	—
Shiraishi	68	♂	+	+	+	+
Shiraishi	19	♀	+	+	+	±

+: present.
—: absent.
Defect of clavicle (±) means hypoplasia.

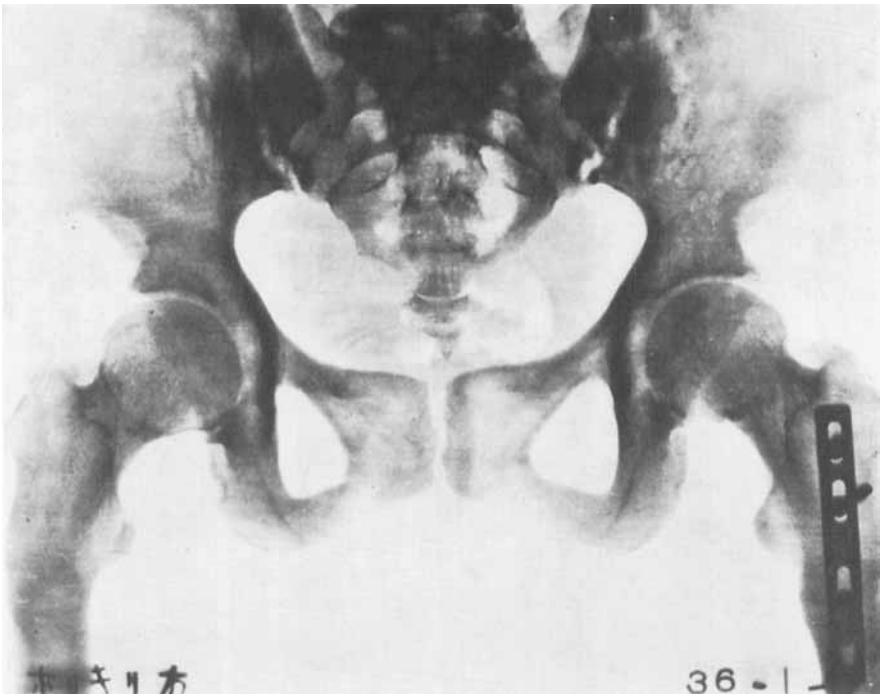


Figure 10: Roentgenogram of pelvis. Case 2. The iliac bones were deformed. There were old subtrochanteric fractures in both femora. Generalized sclerosis of bone was noted.

(Cont.)

Short phalanges	Changes of teeth	Widening of metaphysis	Bone sclerosis	Experience of fracture	Family relation
+	+		+	+	Cousin
+	+		+	—	Brother, Cousin
+	+		+	+	Brother, Cousin
+			+	+	
+		+	+	+	
+	+	—	+	+	

presumably due to lack of remodeling ability. Common findings were also noted histologically. The relationship between the pycnodysostosis and the osteopetrosis is suggested to explain the occurrence of the two diseases in sisters.

Pycnodysostosis presents a number of changes characteristic of cleidocranial dysostosis, such as dwarfism, open cranial sutures, a flat mandibular angle with dental abnormality. In addition, a clavicular defect was also noted clearly in three cases, and as stated before this has not been described in previous reports. Although the developmental anomalies in Case 1 were so marked and typical of the cleidocranial dysostosis, there were also shortening of the distal phalanges and osteosclerosis of pelvis, spine and cranial base with broadening of the long bone metaphysis. The author believes that Case 1 is one closely akin to dysostosis cleidocranialis. In the cases reported as dysostosis cleidocranialis by Fujimoto (1943), Soule (1964) and Fujiwara (1964) one of the features was shortening with tapering of the distal phalanges, and osteosclerosis was interpreted from their photographs. However, the limitation of such a decision as to the presence of bone sclerosis is recognized. Thus the possibility of cases of pycnodysostosis reported under the diagnosis of cleidocranial dysostosis is presented. Histological features of dysostosis cleidocranialis have not been defined, and no report of these two diseases occurring in the same family was found. Pycnodysostosis and cleidocranial dysostosis have much in common as to clinical and roentgenographic data. However, we cannot conclude as to the possibility of a relationship between these two diseases.

According to Shima (1949) and Miki (1963) pycnodysostosis was considered to be the combination of dysostosis cleidocranialis and

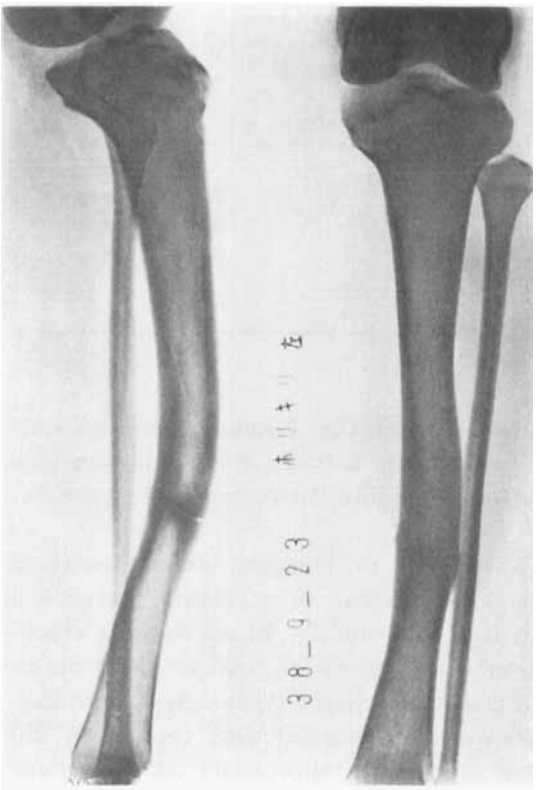


Figure 11: Roentgenogram of the left leg. Case 2. A transverse fracture of mid-tibia in the healing phase was seen with spindle shaped thickening and anterior bowing.

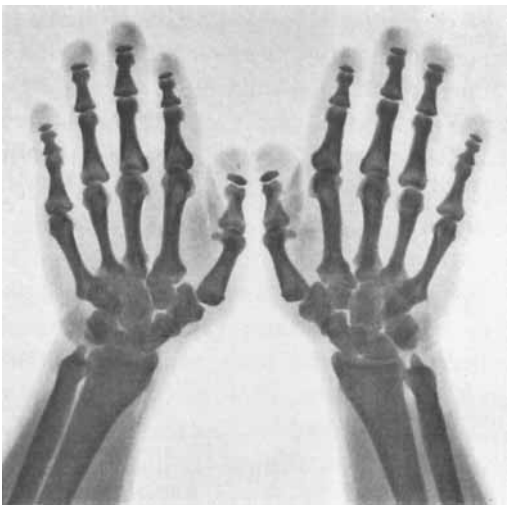


Figure 12: Roentgenogram of hands. Case 2. The terminal phalanges were extremely short. Cortex of the tubular bones was thick. Deformity of the base of the metacarpals was seen.

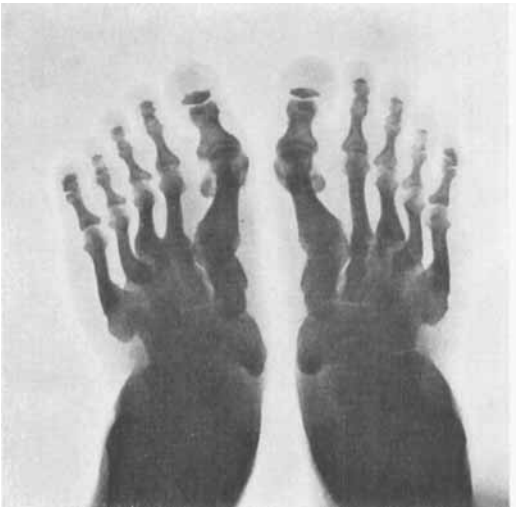


Figure 13: Roentgenogram of feet. Case 2. The terminal phalanges were short and flat. The metatarsals were also short with broad and deformed bases. Cortex of the tubular bones was thick.

osteogenesis imperfecta. They concluded that the sclerosis was a secondary change from fracture healing. The author believes that the bone density is too extensive and diffuse to be considered as bone reaction following a fracture. Because of the presence of generalized bone sclerosis, the type of fracture, and the histological features, the disease entity can be considered to be due to the same unknown factor that probably causes osteopetrosis.

In conclusion, the pathogenesis of pycnodysostosis remains unknown as well as that of cleidocranial dysostosis and osteopetrosis.

SUMMARY

Two cases of pycnodysostosis were reported. Forty-eight cases of open cranial suture and osteosclerosis from foreign and domestic literatures were reviewed.

There were twenty males and twenty-eight females. Dwarfism, open cranial suture, shortening of fingers and toes, osteosclerosis and bone fragility were noted in almost all cases. Flattening of the mandibular angle was found in 65 per cent, broadening of the metaphysis in 19 per cent, dental abnormality in 31 per cent and clavicular defect in 6 per cent. Twenty of forty-eight cases occurred in brothers and sisters, three were cousins (two of them were a brother and his sister), and two were an uncle and his nephew. Histological findings similar to those of osteopetrosis were obtained in four cases.

Pycnodysostosis and osteopetrosis have common features clinically,

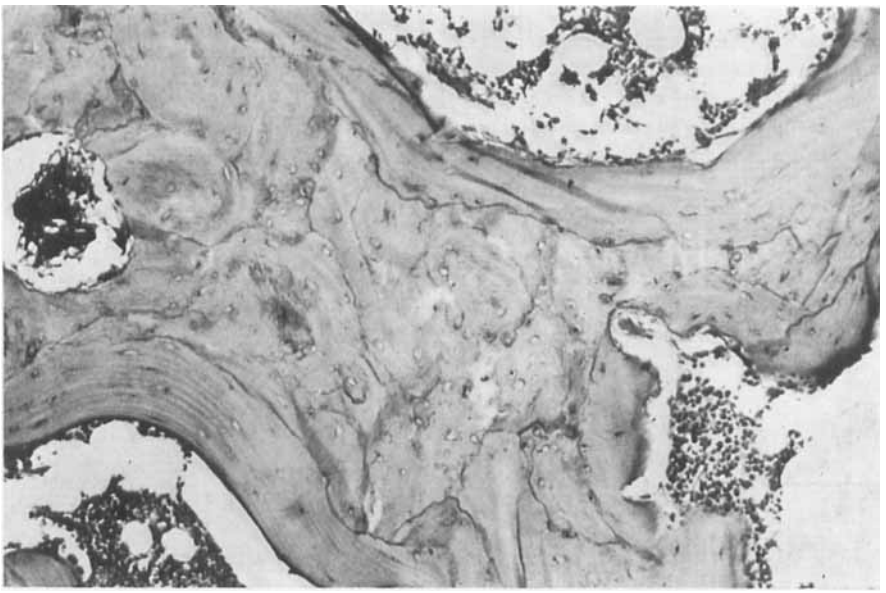


Figure 14: Photomicrograph of bone taken from the ilium. Case 2. The thick trabeculae showed mosaic structure and contained coarse fiber bone and persistent mineralized osteochondroid fragments (hematoxylin and eosin stain, × 60).

roentgenologically and histologically. There was one case of pycnodysostosis whose sister was presumed to be a case of osteopetrosis. Intimate relationship between pycnodysostosis and osteopetrosis is strongly suspected.

Pycnodysostosis has a strong resemblance to dysostosis cleidocranialis both clinically and roentgenologically. However, histological features are not yet clearly described, and no report of familial occurrence of pycnodysostosis and cleidocranial dysostosis was found.

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