

Management of Paediatric Trauma in Siblings with Pyknodysostosis: A Case Report

Mr Scrimshire; Mr Shah F; Mr Bruce C

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Pyknodysostosis is a rare autosomal recessive bone disorder characterized by osteosclerosis, short limbs and short stature. Other features include delayed closure of cranial sutures, frontal and occipital bossing and short broad hands with nail hypoplasia. Patients often suffer multiple long bone fractures following trivial trauma.





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The World Journal of Medical Education and Research (WJMER) (ISSN 2052-1715) is an online publication of the Doctors Academy Group of Educational Establishments. Published on a quarterly basis, the aim of the journal is to promote academia and research amongst members of the multi-disciplinary healthcare team including doctors, dentists, scientists, and students of these specialties from around the world. The principal objective of this journal is to encourage the aforementioned, from developing countries in particular, to publish their work. The journal intends to promote the healthy transfer of knowledge, opinions and expertise between those who have the benefit of cutting edge technology and those who need to innovate within their resource constraints. It is our hope that this will help to develop medical knowledge and to provide optimal clinical care in different settings. We envisage an incessant stream of information flowing along the channels that WJMER will create and that a surfeit of ideas will be gleaned from this process. We look forward to sharing these experiences with our readers in our editions. We are honoured to welcome you to WJMER.

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: Doctors Academy, DA House, Judges Paradise, Kaimanam,

: Trivandrum, 695018, Kerala, India

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Management of Paediatric Trauma in Siblings with Pyknodysostosis: A Case Report

Mr Scrimshire AB, MBBS, MRCS*; Mr Shah F, MBChB, MRCS**; Mr Bruce C, MBChB, FRCS Orth***

Institution

*Core Surgical Trainee, Alder Hey Children's Hospital, Liverpool, England

**Orthopaedic Registrar, Alder Hey Children's Hospital, Liverpool, England

***Paediatric Orthopaedic Consultant, Alder Hey Children's Hospital, Liverpool, England

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Abstract

Pyknodysostosis is a rare autosomal recessive bone disorder characterized by osteosclerosis, short limbs and short stature. Other features include delayed closure of cranial sutures, frontal and occipital bossing and short broad hands with nail hypoplasia. Patients often suffer multiple long bone fractures following trivial trauma.

We present a case report of two children, a brother and sister, who both have Pyknodysostosis. Both are currently well but have suffered multiple lower limb fractures requiring prolonged treatment before weight bearing (mean 5 months). They have both suffered spinal complications including cervical spine fractures and lumbar sclerosis, fortunately with no neurological impairment.

The diagnosis of Pyknodysostosis is an important differential in patients who present to accident and emergency or fracture clinic with fractures secondary to trivial injury. Medical personnel should be aware of this condition, its characteristic features and should not confuse it with non-accidental injury.

Key Words

Pyknodysostosis, Paediatric, Trauma, Cathepsin-K, Surgery

Corresponding Author:

Mr Scrimshire, E-mail: Ashley.Scrimshire@nhs.net

Introduction

Derived from the Greek 'pycnos' meaning 'dense' and 'ostosis' meaning 'condition of the bone',¹ Pyknodysostosis was first described in 1962 by Maroteaux and Lamy² and has an incidence of 1.7 per million.³ Pyknodysostosis is a rare autosomal recessive disorder of osteoclast activity causing osteosclerosis. The genetic defect maps to chromosome 1.⁴

Recognized physical signs of Pyknodysostosis include short stature (under 1.5 meters), short broad hands with stubby fingers, nail hypoplasia, frontal and occipital bossing, scoliosis, delayed closure of cranial sutures, hypoplastic clavicles and multiple long bone fractures following minimal trauma. They may also have a growth hormone deficiency or develop sleep apnoea. Mental and sexual development is usually normal.^{5,6}

Radiographic signs may include osteosclerosis with narrow medullary canals, aplasia of terminal

phalanges, reduced bone age, clavicle hypoplasia, fronto-parietal bossing, calvarial thickening, nasal beaking, persistence of primary teeth, delayed cranial suture closure, obtuse angle of mandible with a short body and sclerosis of vertebral bodies.^{5,6}

Differential diagnoses include Pyknodysostosis, osteopetrosis, renal osteodystrophy, flurosis, lead poisoning and Caffey's Disease.

We present a case report of two patients, a brother and sister, who both have Pyknodysostosis. No other relatives are known to have had the condition.

Patient 1 – The older brother

The brother is now aged 16; he was initially referred to our cardiology and endocrine physicians by his general practitioner aged 1 year with a heart murmur and slow growth. Aged 18 months he then suffered Humerus, Radius and Ulna fractures following minimal trauma. This raised the concern

of non-accidental injury and was investigated thoroughly. As part of the investigation a skeletal survey was performed. It was then that the diagnosis of Pyknodysostosis was suspected.

Subsequent genetic testing of the patient and both parents confirmed the diagnosis. He later underwent surgical correction of pulmonary stenosis and an Atrial-Septal defect, aged 4 years (unrelated to Pyknodysostosis). He requires growth hormone replacement due to an isolated hormone deficiency. He has sustained recurrent mid-shaft Tibia and Fibula fractures annually since the age of 12. Each time these have been treated with closed reduction and plaster cast, taking 4-6 months to heal to weight bearing (See figure 1). He has also developed lumbar spine sclerosis and pars defects at L4 and L5, for which he is treated with analgesia.



Figure 1: a) Mid-shaft Tibia fracture following a trip from standing. Treated with manipulation under anaesthetic and plaster cast. b) Six months post-injury, patient only just weight bearing.



Figure 2: Facial view of the brother aged 16 demonstrating frontal bossing.

On general physical examination he demonstrates short stature, frontal and parietal bossing, short broad hands and nail hypoplasia (see figures 2 and 3). Radiographs show generalized bone sclerosis with reduced medullary canal size throughout the upper limbs, lower limbs, pelvis and spine. They also demonstrate reduced bone age, distal phalangeal aplasia of the hands, an obtuse mandibular angle with a short body and super-numeric teeth (see figures 4 and 5). Older films also demonstrate delayed cranial suture closure and a congenital C2 spondylolisthesis.

Patient 2 – The younger sister

The sister is now aged 10 years; she initially presented aged 2 months via general practitioner referral for an x-ray skeletal survey to investigate frontal bossing and a wide posterior fontanelle. It

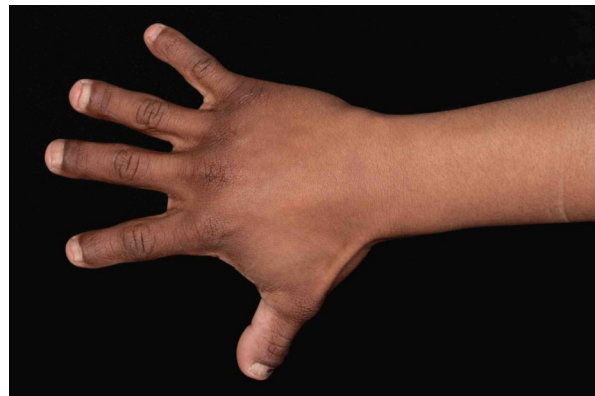


Figure 3: The brother's hand demonstrating a short, broad hand and nail hypoplasia.



Figure 4: Pelvic radiograph showing diffuse bony sclerosis and loss of femoral medullary canal bilaterally.

was then that features of Pyknodysostosis were noted and subsequent genetic testing confirmed the diagnosis.

Unlike her brother she does not have any cardiac problems but does also have congenital C2 spondylolisthesis and an isolated growth hormone deficiency. However, her growth hormone treatment was stopped after 18 months as she developed obstructive sleep apnoea. She now requires continuous positive airways pressure (CPAP) ventilation at night. She has sustained multiple fractures including her fifth metatarsal, clavicle and several Tibial fractures, all following minimal trauma. Each fracture has been treated conservatively with closed reduction and prolonged casting, except the clavicle, which was simply monitored. She has also sustained multiple cervical spine fractures (C2, C3 and C4) and subluxation from performing a forward roll at home. This

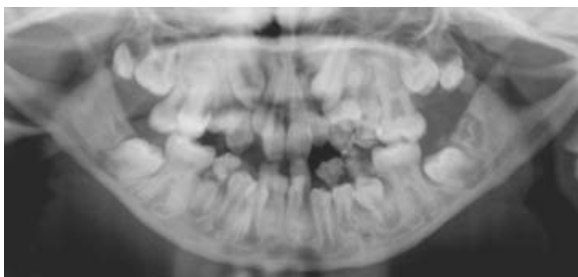


Figure 5: Orthopantomogram demonstrating supernumerary teeth. These required multiple extractions



Figure 6: Facial view of the sister aged 10 demonstrating frontal bossing, depressed nasal bridge and midface hypoplasia.



Figure 7: The sister's hand demonstrating a short, broad hand and nail hypoplasia.

required Halter traction initially followed by prolonged neck collar treatment (18 months in collar). The C3 and C4 fractures healed but the C2 never has, however she has no symptoms from this.

On general physical examination she has short stature, frontal and parietal bossing, depressed nasal bridge, midface hypoplasia, short broad hands and



Figure 8: Radiographs of the sister's right foot demonstrating bony sclerosis and a fractured base of the fifth metatarsal following a minor trauma at home.

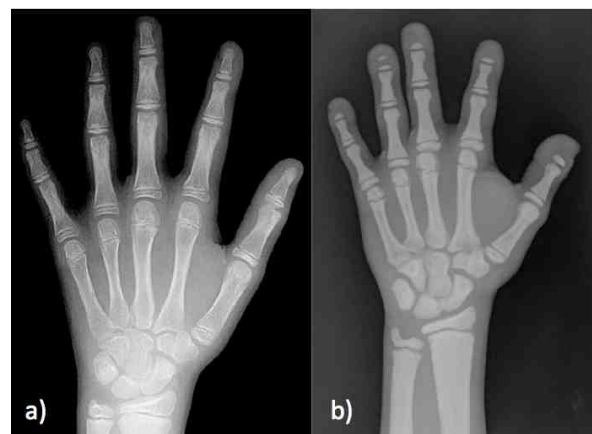


Figure 9: a) Left hand radiographs of a standard 10-year-old girl. b) The sister's left hand radiograph demonstrating reduced bone age, bony sclerosis and aplasia of distal phalanges.

nail hypoplasia. (See figures 6 and 7)

Radiographs demonstrate the same signs as her brother with the addition of distal phalanx aplasia of the feet (See figure 8). Figure 9 demonstrates hand signs and reduced bone age.

Both children are currently well and show normal physical and mental development.

Discussion

The genetic defect of Pyknodysostosis maps to chromosome 1q21 and causes a deficiency in Cathepsin K.⁴ Cathepsin K is a lysosomal enzyme expressed in osteoclasts. It catabolizes Type I collagen in bone reabsorption, which forms the majority of bone matrix. Increased release is stimulated by bone and soft tissue injury. A deficiency in Cathepsin K causes a reduction in bone reabsorption resulting in abnormally dense and brittle bones.⁷ Due to its known bone reabsorptive function Cathepsin K inhibitors are being explored as potential treatments for osteoporosis.^{8,9} Growth hormone deficiency is also seen in Pyknodysostosis. As short stature may be problematic for some patients, hormone replacement therapy is often used as it can increase long bone length and therefore improve linear growth.¹⁰

In our experience fracture reduction and indirect immobilization (i.e. casting, neck collar) are adequate treatment for patients presenting with closed fractures associated with Pyknodysostosis. However prolonged treatment is often required due to slow bone healing. Other methods of fixation such as intramedullary nailing may be difficult, or not possible, due to bone brittleness and reduced medullary canal size, particularly in children. Case reports of intramedullary nailing being used in adult patients were found in the literature,^{11, 12} with some authors even recommending its routine use to prevent future fractures. No cases using intramedullary fixation in children were found. The use of screw and plate based fixation techniques may be possible, but again difficult due to increased bone density and brittleness. No reports of this being used were found in the literature. Anaesthetic approach to these patients also requires careful consideration as intubation is often challenging. The use of spinal or regional anaesthesia may be more appropriate in some patients.¹³

Pyknodysostosis is a rare condition and patients may well know their diagnosis well before presenting to you. However, it is important to be aware of this condition and be able to recognize the classical features, as presentation to accident and

emergency departments or fracture clinic may be their first presentation. Although an index of suspicion should always be maintained when children present with injury patterns not in keeping with the history, Pyknodysostosis should not be confused with non-accidental injury.

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