

## Pathological fractures leading to the incidental diagnosis of rickets

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### INTRODUCTION

Rickets is a bone demineralising disease secondary to Vitamin D, calcium and/or phosphate deficiency, resulting in clinically significant skeletal and systemic permanent morbidities.<sup>1</sup> Vitamin D deficiency rickets is the most common preventable metabolic bone disease in children worldwide,<sup>1</sup> with nutritional Vitamin D deficiency being the most common cause. Other less common aetiologies relate to disorders in the renal, hepatic or intestinal systems.<sup>1</sup> Nutritional rickets has not been eradicated from Canada. In a national survey of Canadian paediatricians, the annual incidence of nutritional rickets was estimated at 2.9 cases per 100,000 in children younger than 3 years.<sup>2</sup> The mean age at diagnosis in Canada is 1.4 years, and the vast majority of the patients are exclusively breast-fed and of darker skin. Recent immigrants and Indigenous Canadians are also at a higher risk of the disease.<sup>2</sup> The incidence of nutritional rickets increases significantly for Indigenous children. Between 2001 and 2010, there were 4.2 cases per 100,000.<sup>3</sup> The Canadian Paediatric Society recommends Vitamin D supplementation of 400 IU/day for all infants during their

1<sup>st</sup> year, increasing to 800 IU/day for Northern Indigenous communities during winter.<sup>4</sup>

Certain findings on the physical examination [Table 1] could suggest the diagnosis of rickets. Furthermore, paediatric visits that entail plain radiographs are common, including limb radiographs in trauma and chest radiographs for respiratory symptoms. Rural family and emergency physicians are usually the first to interpret plain X-rays, and the patient departs before the radiologist interpretation report becomes available.<sup>5</sup> In rickets, osteopaenia and pathological fractures are common due to bone demineralisation.<sup>1</sup> In addition, there are several distinctive radiological signs of rickets [Table 2]. Because of the rapid growth of the epiphysis, in the form of rarefaction of the provisional zone of calcification with the widening of epiphysis–diaphysis distance, rickets most commonly begins at the distal ends of long bones.<sup>6</sup> Infants are more likely to get chest radiography, rather than limb; thus, the early signs of rickets can be observed in the humeral head.<sup>6</sup>

Rural physicians could initiate treatment upon the initial diagnosis by recommending parents increase their child's intake of high-Vitamin D food,

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such as fatty fish, increased sunlight exposure and Vitamin D supplementation. All patients suspected to have rickets should be referred to a paediatric tertiary care centre for a further work-up to rule out less common causes of rickets. In addition, because of the low impact needed to induce fracture in rachitic bones, pathological fractures could be mistakenly reported as non-accidental fractures due to child abuse or neglect.

CASE HISTORY

A previously healthy 17-month-old Canadian boy of South-Asian descent was brought into the emergency department of a rural hospital by his parents after sustaining a minor injury. His parents stated that he fell from standing while he was trying to reach a toy on the floor. Since then, he had refused to use his left upper limb and cried whenever the forearm was touched. A focussed physical examination revealed intact skin, no obvious deformity, normal spontaneous range of motion of the elbow and wrist with mild swelling and localised tenderness over the distal forearm.

An X-ray of the left forearm, including the wrist joint, was obtained. The anteroposterior view [Figure 1] and lateral view [Figure 2] demonstrated buckle fractures of the distal radial and ulnar diaphyses. In addition to the positive radiological findings, directly related to the patient’s visit, there were other incidental findings. These included osteopaenia, concave metaphyses, widening of the metaphyseal ends and brush-like metaphyseal margins. Based on the radiological findings, the diagnosis of rickets was suggested.

Further history revealed that the patient was exclusively breast-fed. As a result, nutritional counselling was provided to his parents. The patient was treated with a forearm splint and Vitamin D supplementation. The parents were also recommended to increase his exposure to sunlight and introduce a diet rich in Vitamin D.

Table 1: Physical examination findings <sup>[1]</sup>	
Location	Clinical features
Head	Frontal bossing: Expansion of cranial bones relative to facial bones Craniotables: Softening of skull bones on palpation delayed closure of the anterior fontanelle delayed dentition
Chest	Harrison sulcus: A transverse chest wall sulcus created by the diaphragm pulling on the weakened ribs Pigeon chest: Forward projection of the sternum Rocket rosary: Beads along the costochondral junction
Limbs	Bowing: Genu varum or valgus Recurrent fractures with minor mechanism of injury Delayed standing or walking

Table 2: Radiological findings of rickets <sup>[1,6]</sup>	
Bones	x-ray findings
Long bones	Cupping: Concave metaphysis Fraying: Feathery metaphyseal margin Splaying: Widening of the metaphysis Bowing of the diaphysis Widening of the physis The white line of Frenkle: Ossification of a provisional zone of calcification in healing rickets
Chest	Rachitic rosary: Bulbous costochondral enlargement Humeral head: Long bones findings (see above)
Spine	Biconcave vertebral bodies Scoliosis Triradiate pelvis



Figure 1: The anteroposterior view of the wrist joint



Figure 2: The lateral view of the wrist joint

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In addition, to rule out other less common causes of rickets, the patient was referred to a paediatric tertiary care centre for a further work-up. Given the diagnosis and pathological nature of the injury, and the absence of other red flags of child abuse/neglect, a non-accidental injury report was not initiated.

## DISCUSSION

Rickets is re-emerging in Canada. Children with undiagnosed rickets continually present to rural physicians. The initial diagnosis of rickets can occur incidentally on plain radiographs. Given that rural physicians are the first to interpret their patients' plain radiographs and the potential prevention of the profound morbidity of the disease, there is an urgent need for heightened awareness among rural physicians to recognise the disease among infants with dark skin, Indigenous and exclusively breast-fed infants. Finally, the knowledge and identification of the radiological features of rickets would aid rural physicians in distinguishing those fractures from non-accidental injuries. As a result, this will avoid wrongfully accusing the parents of

non-accidental injury and the unwarranted reporting to Children's Aid Society (CAS). Because nutritional rickets is more prevalent among Indigenous and recent immigrant children, CAS reporting could further contribute to them experiencing an unintended racial discrimination when accessing health-care.

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