

Pathological Fractures in Children with Neuromotor Disabilities

What is a pathological fracture?

Fractures may occur when an exceptional force is applied to a limb or bone. A fracture is said to be pathological when it occurs following a routine or minor force and is due to bone weakness. This can occur during the routine tasks of the day.

How do pathological fractures affect individuals?

Pathological fractures not only cause immediate disability due to pain and swelling but may also create a decrease in limb functioning due to treatment, such as joint stiffness due to immobilization, and possible residual deformity of the healed limb.¹

Why do pathological fractures occur?

Bone weakness can occur due to one or both of the following mechanisms: changes to the bone mineral build-up mechanism and lack of mechanical loads.² Bone formation is dynamic and responsive to the needs placed upon it. Generally, a child's skeleton is capable of handling the loads it experiences. Research indicates that muscles are the primary shapers of bone mass by the forces they communicate to bones.³ A non-ambulatory or immobilized child places little force through their body and has little muscle activity to help maintain strong bones.

Bone strength can be further compromised by certain drugs like anti-epileptic drugs⁴, or by feeding difficulties.^{5,6} Fractures occur when bones are weak in comparison to the task they are subjected to. Pathological

fractures can occur following minor or minimal trauma such as manipulation during therapy, turning in bed, or falling from the seated position. Pathological fractures can also occur without any specific traumatic event noted and may be caused by nothing more than the normal activities of daily living.

Who is at risk?

Children with disabilities have a high prevalence of osteoporosis and osteoporosis-related pathological fractures.⁷ Pathological fractures occur frequently in children with the genetic condition osteogenesis imperfecta (brittle bone disease). Bone weakness or reduced bone density is common in many other conditions such as cerebral palsy (CP),⁸ Duchenne muscular dystrophy (DMD),^{9,10} meningomyelocele (MM),¹¹ and spinal cord injury (SCI).¹²

Immobility or being non-ambulatory can also contribute to bone weakness. It is therefore not surprising that bone density appears to be correlated with the child's level of physical involvement.^{5-7,13,14} Immobility can result from neuromuscular weakness,¹⁵ casting and/or post-operative immobilization,^{7,16,17} joint dislocation, stiffness, or contracture.⁷

Altered hormone levels, insufficient diet and some drugs can also contribute to bone weakness (osteopenia).^{5,6,9,13,18}

This can occur directly by affecting bone strength or indirectly by disturbing muscle strength, which in turn affects bone loading and ultimately bone strength.³ Research has revealed that the following risk factors are associated with lower bone density: higher level of neuromuscular involvement,^{5-7,13,14}

previous fracture(s);¹⁶ inadequate intake of crucial vitamins (calcium, vitamin D);¹⁸ difficulty feeding;^{5,6} use of a gastrostomy tube;¹⁶ higher body fat;¹⁶ and exposure to anticonvulsant medication.⁶

How often do pathological fractures occur in children who are non-ambulatory?

The incidence of pathological fractures in this population of ambulatory and non-ambulatory children varies from 5 to 29 percent^{8,9,16, 17,19-21} with the exception of vertebral fractures in children with DMD taking corticosteroids over a prolonged period of time in which case the incidence is as high as 75%.⁹ In children with CP, the majority of fractures occur in the femur.⁷ Many children also sustain more than one fracture.¹⁶

How should I "handle" a child prone to pathological fractures?

Health care professionals and all caregivers who provide hands-on care or assistance need to exercise caution when handling the child and/or the child's limbs. This does not mean that a hands-off attitude should be adopted. It is currently not known "how much" or "how little" force to apply to the child's limbs just that care is warranted.

How can I identify a pathological fracture in a child who is non-verbal?

There should be a high index of suspicion of pathological fracture in children who are immobile. Signs/symptoms of a pathological fracture in this population may include pain, swelling, deformity, discomfort, irritability and/or change in behavior or sleeping patterns. Parent concerns about swelling and/or deformity need to be

reported and acted on without delay. The limbs of children who are immobile or who have spasticity can look different from those of other children. If you are unfamiliar with a child whom you are concerned about, ask someone who knows the child well if the appearance of a limb is normal or not for the child.

What should I do if I "suspect" a pathological fracture?

Clearly document the signs and symptoms you observe as well as any changes in the child's normal routine. You should notify the child's physician of your concerns and document the actions you have taken. Ask the child's parents or other caregivers if they have noticed changes in the child's appearance or behaviour. A prompt and thorough physical examination by a physician should be completed with detailed documentation of findings in the chart. Persistent irritability especially with localizing symptoms should alert the physician to consider a bone scan, even in the absence of obvious signs of swelling or deformity.

How can I help prevent pathological fractures?

Awareness of the potential level of risk for each child, careful handling during assisted movements and avoidance of excessive forces during daily activities are all strategies to decrease the occurrence of fractures. A survey of professionals and caregivers conducted by Sunny Hill Health Centre revealed that many were unaware of the risk of pathological fractures and prevention strategies for children with neuromotor disabilities. Ongoing education of children, caregivers, support personnel and fieldwork students is

required to ensure that all are fully aware of the risks and prevention strategies. Family-friendly written materials, such as the *Healthy Bones* pamphlet developed by Sunny Hill Health Centre, may be useful for supplementing individualized education.

In addition, evidence suggests that a weight-bearing program can help increase bone density in certain children, for example children with CP.^{22,23} It appears that increasing the length of time children spend in a weight bearing position can have direct effect on increasing bone density in the vertebrae.²² These programs should be implemented cautiously by a physiotherapist. Also, certain essential nutrients such as vitamin D and calcium may help decrease the risk of osteopenia in children who are non-ambulators.^{4,24} Many pharmaceuticals are currently being studied and may help increase bone density. By increasing or maintaining bone density, children are less likely to suffer pathological fractures in the future.

This evidence summary was updated by Tanja Mayson (MSc, BScPT) on March 31st, 2007. The original literature review was written by David Jordan (BScOT) in 2002. A literature search was completed using the search terms: bone density, osteopenia, osteoporosis, fracture, developmental disability, cerebral palsy, meningomyelocele, muscular dystrophy, brain injury, and spinal cord injury. CINAHL, Medline, EMBASE, and EBM Reviews were searched with limits for ages (0-18 years of age) and publication date (1980 or more recent).

A caregiver brochure entitled "*Healthy Bones: Information for Caregivers of Children with Neuromotor Disability*" is available through the Sunny Hill Education Resource Centre (SHERC) website:

<http://www.cw.bc.ca/library/pdf/pamphlets/HealthyBones2007Read.pdf>

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