



# POSNA

The Pediatric Orthopaedic Society of North America

## Achondroplasia

### Objectives

1. Describe the genetics and pathophysiology of achondroplasia
2. Describe the clinical features of achondroplasia in the newborn and in the older child
3. Describe spinal problems associated with achondroplasia
4. Discuss indications for lengthening in achondroplasia
5. Discuss the long-term outlook for children with achondroplasia

### Discussion points

1. What are the financial costs of lengthening for achondroplasia? The physical costs?
2. Is administration of growth hormone of value for children with achondroplasia?
3. What is hypochondroplasia?

### Discussion

Achondroplasia is the most common cause of disproportionate short stature. The molecular basis has been established as an abnormality in FGFR-3. Most cases result from a sporadic mutation, but achondroplasia is transmitted as an autosomal dominant. Increased paternal age has been identified as a causative factor. It is caused by a mutation in a single base pair resulting in a single amino acid substitution in the receptor. Achondroplasia is an example of what is called a positive mutation in that the action of the defective receptor appears to control the rate of longitudinal growth, since knockout studies of the FGF-3 receptor in mice results in longer bones. Therefore, cell columns in the growth plate are small, and the hypertrophic zone is narrow. Since

cartilage cell proliferation in the growth plate is the engine behind longitudinal growth, there is a disproportion between longitudinal and latitudinal growth.

Infants with achondroplasia demonstrate an enlarged neurocranium (intermembranous ossification), midface hypoplasia, and relative prominence of the mandible. The limb shortening is rhizomelic (predominately in the proximal segments), and the trunk is relatively long. Most achondroplastic children develop a thoracolumbar kyphosis before walking age. The clavicles are normal in length, the skin is loose with a bulky muscle mass, resulting in a husky appearance. Hip flexion contracture and exaggerated lumbar lordosis are common. Usually pronounced genu varum results from weightbearing. Sitting height normal, expected adult height is 132 cm for men, 125 cm for women.

Standard growth charts are available for achondroplasia. The bony spinal canal is coned down in shape in the lumbar spine, rather than the normal enlarging as it extends distally in the lumbar spine. The pedicles are short and problems related to spinal stenosis and/ or nerve root impingement are common. The foramen magnum is also small and is another site of potential CNS impingement. Early MRI studies to assess the status of the foramen magnum have been recommended.

The most frequent orthopaedic problems in achondroplasia are spinal. The thoracolumbar kyphosis of infancy usually resolves spontaneously. However, perhaps up to 20% do not resolve. Bracing has been advocated for control of unresolving kyphosis, with good results reported. Wide decompressions may be necessary to treat symptoms of spinal stenosis, which often becomes symptomatic in late adolescence or adulthood. Tibial and fibular osteotom are routinely used to treat genu varum. Fibular epiphseodesis, if performed early, may correct genu varum without need for osteotomy. Two of the most contentious issues at present in treatment of achondroplasia are whether to administer growth hormone, or whether to embark on a lengthening program. Generally, tibial, femoral and humeral lengthenings are required to achieve a proportional end result. This is certainly an arduous undertaking, and present thought is unsettled although there is no question that function can be increased following lengthening. The Little People of America have not been enthusiastic about lengthening. Data on the effectiveness of growth hormone is still preliminary. Despite all the potential problems associated with achondroplasia, surveys of schoolchildren and adults find most doing very well. Physical or mental component scores for adults with achondroplasia do not differ from those of the general population until about age 40, when back pain and arthritis become more problematic.

Hypochondroplasia is phenotypically similar to achondroplasia, although shortening is more mild. Although also transmitted as an autosomal dominant, the genetic focus of the mutation is not the same as that documented for achondroplasia.

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