

S1 The Role of Diagnostic Imaging in the Diagnosis of Melorheostosis

Objectives

- Define melorheostosis and examine the signs and symptoms associated with the disease.
- Describe the imaging modalities used in the diagnosis of melorheostosis and treatment options.

Defining Melorheostosis

- The National Organization for Rare Disorders (NORD) defines melorheostosis as a rare disease that affects the growth of the outer layers of cortical bone causing them to abnormally thicken, which is also known as hyperostosis. (National Organization for Rare Diseases (NORD), 2024)
- NORD also states that melorheostosis typically occurs unilaterally in the upper or lower extremities of the appendicular skeleton but can also affect parts of the axial skeleton such as the ribs, pelvis, and or sternum.
- The irregular growth connected to melorheostosis is benign, making it a noncancerous disease and it does not spread from bone to bone. (Medlineplus, 2018)

Common Signs and Symptoms

According to NORD these are the most common signs and symptoms associated with melorheostosis, most often presenting themselves in childhood to early adulthood:

- Difference in limb lengths (one being shorter than the other)
 - Restricted range of motion
 - Stiffness and pain
 - Edema (swelling) of the upper or lower extremities
 - Edema can also occur in the joints which can lead to deformed or immobile joints
 - Abnormalities of the soft tissues
 - Shortened tendons and ligaments
 - Abnormal or absent muscles
 - Buildup of calcium in the tissues
- (National Organization for Rare Diseases (NORD), 2024)



Melorheostosis | Radiology case | [Photograph]. radiopaedia.org.Radiopaedia. (n.d.).<https://radiopaedia.org/cases/melorheostosis-18>

The images above are of an 11-year-old girl's hand, PA and oblique projections, who was diagnosed with melorheostosis. They demonstrate the difference in the length (shortening) of her third finger compared to the rest, which is a common sign of melorheostosis.

Imaging Modalities Used in the Diagnosis of Melorheostosis

- The primary cause of melorheostosis is a mutation in the MAP2K1 gene. This gene creates a protein that determines the growth of the bone cells. The mutation of the gene is what causes the abnormal thickening of the outer layers of bone. (MedlinePlus, 2018)
 - Melorheostosis occurs in about 1 in 1 million individuals, with only 400 cases reported around the world.
- The mutation in the MAP2K1 gene that causes melorheostosis is somatic, meaning it changes the DNA structure after conception and is not passed down from the affected individual's parents. (National Organization for Rare Diseases (NORD), 2024)
- According to NORD, general x-ray imaging is the preferred diagnostic tool for identifying melorheostosis. The disease has the appearance of "candle wax dripping" on general x-ray images, which is why it is sometimes referred to as "the candle wax disease".
- MRI is not typically used in the diagnosis of melorheostosis, but it can be helpful in evaluating soft tissue injuries and bone marrow invasion caused by this disease.
- CT can provide more detailed imaging and has the ability for 3D reconstruction of the bone for further evaluation.

Treatment Options for Melorheostosis

There is no definitive cure for melorheostosis, however, there are multiple treatments that have been proven effective in controlling symptoms associated with this disease.

• CONSERVATIVE/MEDICAL MANAGEMENT:

- Medications include NSAIDs, analgesics, and bisphosphonates (used to control pain and limit metabolic activity).
- Physical therapy is an option used to help maintain and improve overall physical mobility and strength. Occupational therapy can be used to help tune fine motor skills that are used in daily activities and may have become more difficult to do as the disease progresses, such as getting dressed. (Cleveland Clinic, 2025)

• INTERVENTIONAL/SURGICAL MANAGEMENT:

- Surgery can be used to remove the excess bone and reshape them if functional impairment, severe pain, or deformity occur (National Organization for Rare Diseases (NORD)).
 - Bone density from melorheostosis makes surgery difficult to perform and there is a very high recurrence rate.

Figure 1



Koca, E., Kavak, Ş., Demir, B., Comunoglu, N., Kantarci, F., & Koca, O. (2025). Fig 1 [Photograph]. *Melorheostosis: Clinical, radiological, and histopathological features with a literature review. Physiological Reports*, https://www.researchgate.net/publication/397482074_Melorheostosis_Clinical_radiological_and_histo-pathological_features_with_a_literature_review

- **Image (a)** is a plain radiograph showing progressive cortical hyperostosis (thickening of the outer bone layer) along the side of the radius in the forearm and the proximal phalanx of the 1st digit.
- **Image (b)** is a 3D computed tomography (CT) reconstruction, which further highlights the extensive, irregular bone growth.
- **Image (c)** is a magnetic resonance imaging (MRI) scan, which shows the relationship between the abnormal bone and the surrounding soft tissues, such as muscles.

Conclusion

Melorheostosis is a rare disease that causes the outer layers of cortical bone growth to abnormally thicken. Many signs and symptoms are associated with the disease such as pain and stiffness and a difference in the length of limbs. Melorheostosis only occurs in about 1 in 1 million individuals, with only 400 known cases worldwide. Diagnostic X-ray images are the preferred modality for diagnosing melorheostosis. Although not usually a primary diagnostic tool for this disease, CT and MRI can both be used to provide more information, detail, and extent of the disease. Though there is no cure, many treatments are available, ranging from NSAIDs to surgical intervention to help ease discomfort associated with the disease.