It is very common for the first sign of Charcot-Marie-Tooth (CMT) to show up with symptoms and deformities that are seen in the feet and lower leg of a child or adolescent. This is due to progressive weakness of the muscles in the lower extremity causing muscle imbalance and related deformities. Doctors of Podiatric Medicine (DPM), also known as podiatrists, specialize in the diagnosis and surgical treatment of conditions of the feet and ankles. Approximately 15,000 podiatrists throughout the country are positioned at the front line for early detection of CMT.

**Diagnosis**

Common symptoms from a child/adolescent with CMT:
- I feel off balance and trip a lot.
- My feet and legs hurt at the end of the day.
- The other kids make fun of the way I walk.
- I have a hard time lifting my toes up when heel is on the ground.
- I get burning and/or feeling of pins and needles in my feet and/or hands.
- I have a hard time doing things like using zippers, buttons and writing.
- I have burning pain in hands and/or feet.
- I have a hard time with very cool and cold temperatures.
- I have burning and/or feeling of pins and needles in my feet and/or hands.
- I have a hard time doing things like using zippers, buttons and writing.
- I have burning pain in hands and/or feet.
- I have a hard time with very cool and cold temperatures.

Common reports from parents with a child with CMT:
- My child does not like to participate in sports or gym.
- My child frequently complains that their feet and ankle hurt at the end of the day.
- My child avoids family activities that require lots of walking.
- My child looks clumsy when they walk and and/or run.
- My child walks on the outside of my foot.
- I have a hard time finding sneakers and shoes that fit and are comfortable for my child.
- My child’s feet slap the ground when they walk.
- My child’s arch gets higher and higher over time.
- My child’s shoes wear on the outside.
- My child complains when it is very cool or cold.

There are various ways of diagnosing CMT, including Deep Tendon Reflex (DTR) assessment (use of a reflex hammer to assess the ability of the nerve to stimulate muscles effectively), Nerve Conduction Velocity (NCV), Electromyography (EMG), Manual Muscle Test (MMT), Nerve Biopsies, and Genetic testing. Advanced imaging (such as Magnetic Resonance Imaging or MRI) has yet to show promise with respect to diagnosing CMT, yet it has prognostic value in central nervous system imaging to establish rehabilitation potential for these patients. Some studies advocate for its use in demonstrating muscle atrophy secondary to demyelination with correlation with MMT.

Clinically, patient presentation is highly reliable in diagnosing one with CMT. In 1963, Brewerton and colleagues first demonstrated the association of individuals with symptomatic high arch feet and neurologic abnormality. Results showed that 2/3 of the study population presented with these conditions. Patient history and physical examination will reveal various findings such as the pathologic foot structure (high arches known as Pes Cavus / Cavovarus or Equinovarus deformity), presence of digital contractures (claw toe deformity), tripod of foot (suggestive of a rigid forefoot deformity), lateral ankle instability, and gait abnormality. Gait abnormality will require a complete biomechanical exam evaluating the patient for pelvic elevation or pelvic...
tilt, followed by observation for characteristic shuffling of the feet, high steppage (or Marionette Gait), and signs of excessive tilt of the heel. In addition to mobility problems and deformity, patients often report sensory deficits, primarily with proprioceptive / vibratory sensation as well as protective sensation, which can precipitate cutaneous compromise leading to ulceration.

**Treatment**

Conservative treatments for CMT primarily involve the use of accommodative bracing and supportive measures for palliative care of symptoms. A multi-disciplinary approach is optimal, with incorporation of Physical Therapy / Physical Medicine and Rehabilitation (PMR). Currently, no systemic treatments are available for CMT, yet ongoing research has shown some promise.

Conservative podiatric treatment for CMT patient:
- Shoe gear counseling
- Palliative care, treatment of callouses and corns
- Custom made orthotic devices
- Non-custom ankle-foot-orthosis
- Padding and strapping
- Physical and occupational therapy

Given the relatively slow progression of this disease, conservative goals are centered on mechanically controlling the deformity. These treatment modalities are reserved for individuals with a controllable deformity or who are deemed poor surgical candidates. Examples include:
- Orthotic footwear: Extra-depth accommodative shoes with multi-density inlays can provide support of boney prominences and prevent progression of claw toe deformity by limiting deforming forces secondary to muscle atrophy.
- Molded Ankle Foot Orthoses (MAFO): In conjunction with proper footwear, MAFO may provide added benefit in controlling the deformities by supporting poor functioning lower extremities. Further, MAFO may provide control at the ankle level and assist with drop foot deformity by allowing clearance of the ground during gait in swing phase and provide a stable construct for propulsion during the last phase of the gait cycle.

Proper orthotic devices can greatly reduce the chance of tripping and will help reduce injuries during physical therapy.

In addition to mechanical interventions, physicians have been able to treat CMT patients with physical and occupational therapy. Strength training may assist patients in decreasing severity of contracture from muscle imbalance. Not only does this training help improve function of weakened muscles, but it also helps to maximize the strength of uninvolved muscles. Studies show that even a small increase of strength in affected muscle can result in significant improvement on patients.

When the decision is made to treat a patient surgically with CMT, it is important to consider the apex of the deformity, which of the motor units remaining are functional, how flexible or rigid the established deformities are, and whether ligamentous laxity is present. Goals of surgery are that all fixed deformities must be corrected, including muscle / tendon imbalances in order to prevent recurrence.

Correcting these deformities before any further progression takes place will have a positive impact on the outcome of the surgical procedures. The long term results of surgical correction show positive outcomes, including a slower progression of deformities and a more functional life with less discomfort.

Ultimately, the goals of podiatric treatment of CMT patient are to
- Relieve functional deterioration
- Decrease severity of contractures
- Improve function of weakened muscles
- Help maximize strength of uninvolved muscles
- Mechanically controlling the deformities.

It is recommended that patients with CMT consider a visit to a podiatrist for consultation.