



*Care for people affected by
Charcot's Neuroarthropathy*

**GUIDELINES FOR HEALTH
PROFESSIONALS**



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Presentation



In the current technological era with the facilities of digital communication, which mainly provide convenience for people who live in large cities, we are experiencing a silent epidemic called Diabetes Mellitus (DM) (1). The alarming growth of this disease is related to obesity, lifestyle, an increase in the rate of urbanization, the longer survival rates of people with the disease, and an ageing population (2-4).

Diseases secondary to DM are consequences of poor metabolic control and they develop gradually (5, 6). Microvascular and macrovascular complications can affect different body systems, resulting in serious and irreversible damage (3, 5, 7). Among these complications, considered as one of the most serious, alterations in the feet are prominent, (8), which affecting 40 to 60 million people worldwide (4).

The causes of the development of diabetic foot syndrome are listed as chronic hyperglycemia, diabetic peripheral neuropathy (DPN), deformities, peripheral arterial disease (PAD), and foot alterations (8, 9). The combination of these alterations and the progressive evolution results in complications such as ulcerations, infections, and dreaded amputations (9) (10). Considering the poor prognosis of these patients, the mortality rate can be as high as 45% in the case of neuropathic ulcers, and 55% in ulcers with ischemic involvement, in five years time. This mortality rate is worrying, since it reaches higher levels of some common types of cancer, and should be seen as a serious warning sign (11).

As it is responsible for a considerable prevalence of amputations, another important complication to be recognized is Charcot's Neuroarthropathy (NC) (12-15), a disease that is poorly discussed and often not even recognized by health professionals. Secondary to severe peripheral neuropathy, it is a devastating and disabling condition (9, 16-20). The early diagnosis of CN is neglected in most cases and the presentation of warning signs in the inflammatory phase goes unnoticed (21, 22).

Often, the nurse is faced with this condition and, as a specialist, has an important role in making and conducting decisions. Therefore, recognition and immediate action are the main keys to successful treatment and only immediate action can prevent more serious damage, such as amputations (7, 9, 14, 17, 23-27).

Given the need for scientific updating of nurses on Charcot's Neuroarthropathy, the Stomatherapy Research Group: stomas, acute and chronic wounds, and urinary and anal incontinence, from the School of Nursing, University of São Paulo (GPET-EEUSP), in partnership with the Brazilian Association of Stomatherapy (SOBEST), developed this manual aiming to guide professionals working with the DM population. This manual was prepared based on the Master's thesis entitled: Incidence and risk factors for amputation due to Chacort's neuroarthropathy in diabetic patients: a retrospective cohort, defended in 2020 by the Master of Science, Mariana Alves Bandeira, under the guidance of Prof Dr Vera Lucia de Conceição de Gouveia Santos by the Postgraduate Program in Adult Health Nursing at the School of Nursing at USP (PROESA EEUSP). Here, efforts were combined using a bibliographic review of recent publications, national and international guidelines, in addition to the collaboration of specialists on the subject.



Summary



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Introduction

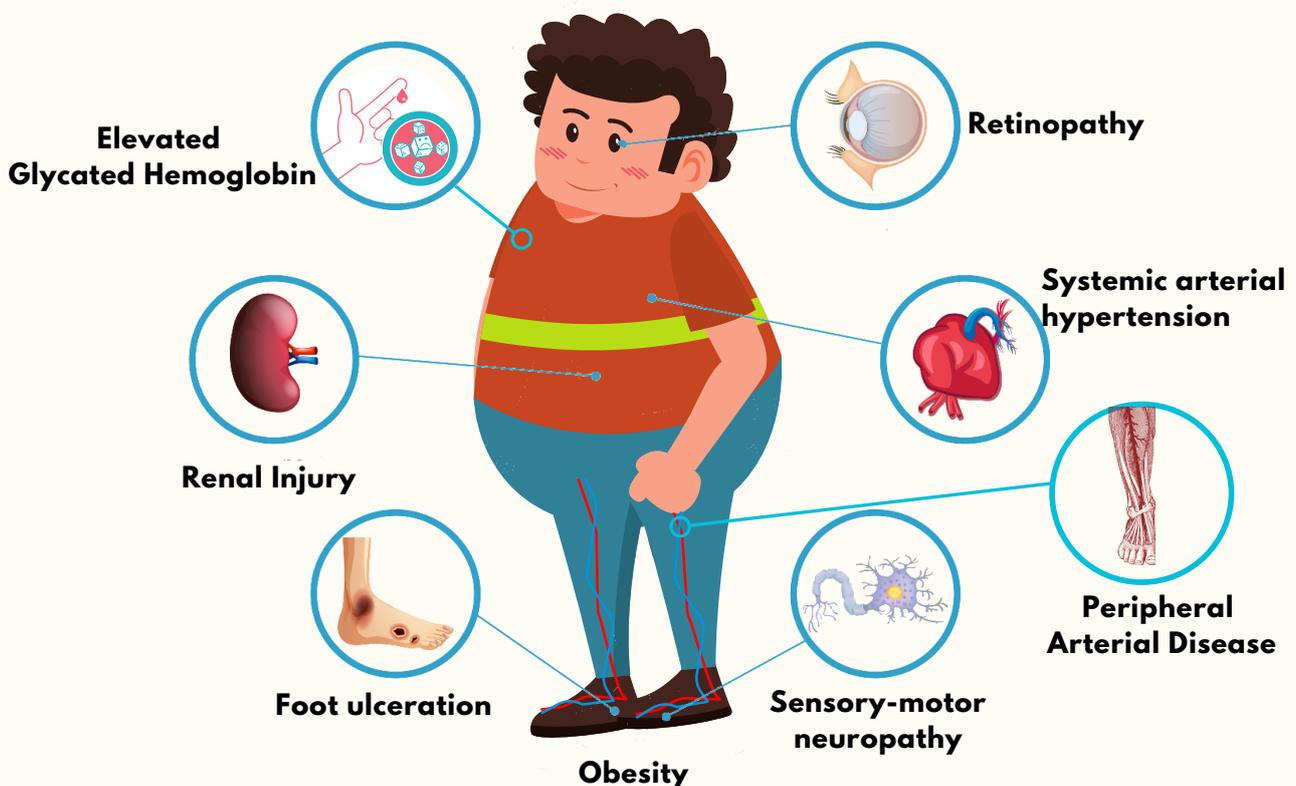
Concept and Epidemiological Data

Charcot's Neuroarthropathy (CN) is a neurotraumatic, inflammatory and non-infectious clinical condition of the feet and ankles, which consists of progressive and degenerative destruction of the bones and joints of the feet. It was initially described by J.M Charcot in 1868, associated with syphilis and, only in 1936, W.R Jordan described it in a patient with Diabetes Mellitus (DM) (28, 29).



An ulcer caused by foot alterations due to CN, secondary to DM. Images published with permission.

Predisposing factors for the development of CN:



References: (13, 15, 21, 30-36)

In more recent epidemiological studies, the prevalence of CN ranges from 0.01 (37) to 9.8% (38). Incidence studies are scarcer and older, and demonstrate different results:



Incidence in Denmark:
0.3% over 10 years (39)



Incidence in China:
2.9% in 12 years (40)



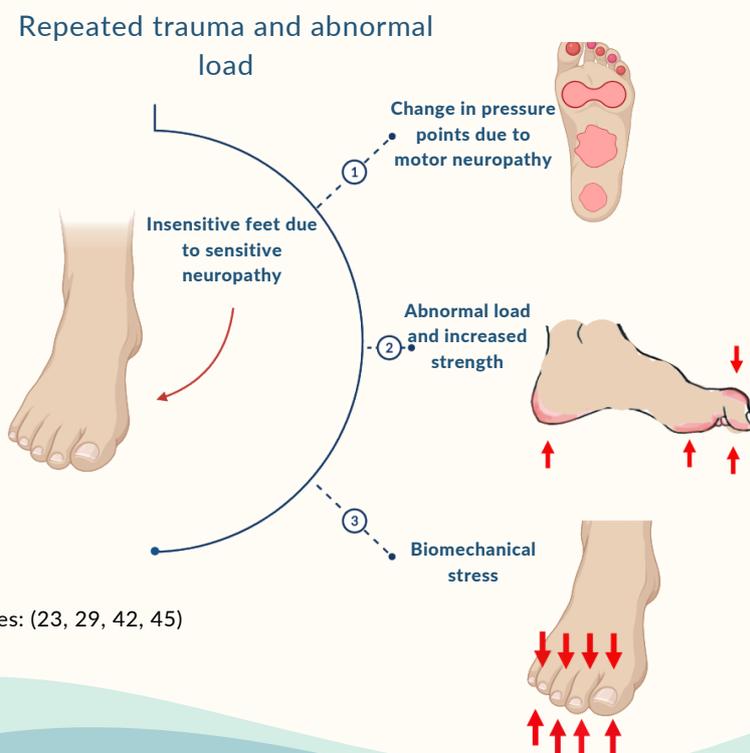
Incidence in the United States:
8.5 / 1000 people per year
(highest rate observed) (41)

This diversity of the results occurs due to the lack of clarity in the clinical and radiological diagnostic criteria (42), as well as due to different methodologies used.

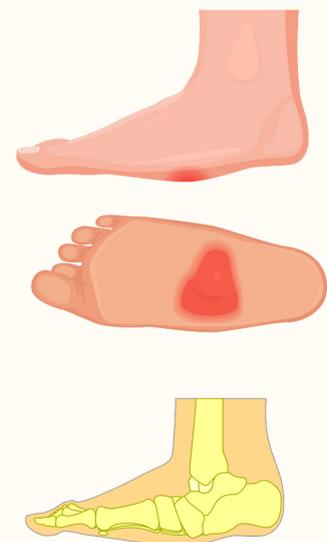
Pathophysiology of the Disease Development and Severity Process

CN can present itself in two phases, acute (active) and chronic (inactive) (30, 43). Even after decades of its relationship with DM, its pathophysiology is still not well defined (44). However, there are two more accepted theories, neurotraumatic and neurovascular. The combination of both is considered to be the vicious cycle of CN (29), as explained below:

Neurotraumatic Theory:



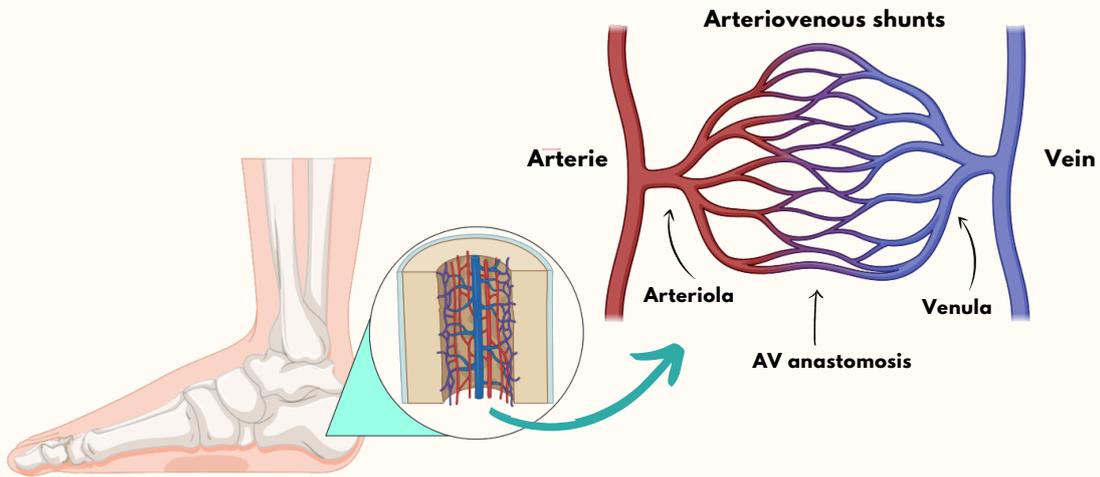
Joint dislocations, microfractures and subluxation (29, 44).



References: (23, 29, 42, 45)

Neurovascular Theory:

Neurovascular theory suggests that autonomic neuropathy is responsible for a hypervascular state caused by arteriovenous shunts that are responsible for increasing blood flow in the bone by up to 60%, leading to osteopenia, bone resorption and consequent bone weakening, which can result in spontaneous microfractures (29, 34, 42).

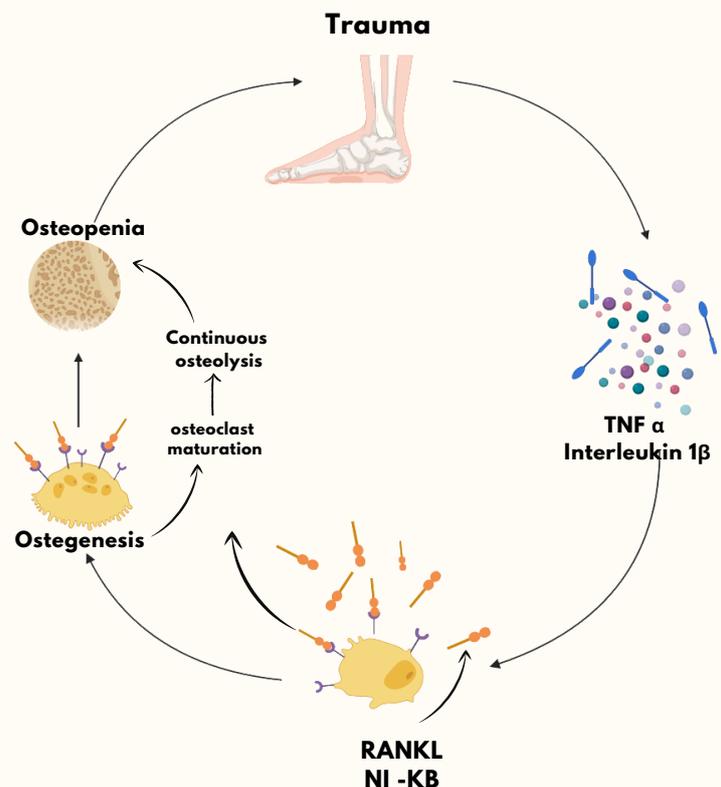


The exacerbated inflammatory response in the acute phase of the disease is linked to the association between the two theories mentioned (42).

The acute process begins and is characterized by the release of pro-inflammatory cytokines, such as tumor necrosis factor α and interleukin 1β , leading to increased expression of the nuclear factor polypeptide activating receptor κB and its RANKL ligand to local cells. RANKL triggers the production of nuclear factor κB and the maturation of osteoclasts. Frequent fractures and the recurrent inflammatory process lead to continuous bone resorption (osteolysis), which is a vicious cycle (9, 16, 45).

During the acute phase, clinical signs of inflammation are observed and if there is no therapeutic intervention, the vicious cycle sets in and the deformity in the feet becomes more severe (42), leading to total breakdown and destruction of bones and joints of the feet (7). Other factors are also currently discussed, such as chronic hyperglycemia, which causes weakening of ligaments and tendons, and low bone density, especially in type 1 DM (46).

Exacerbated inflammatory response:

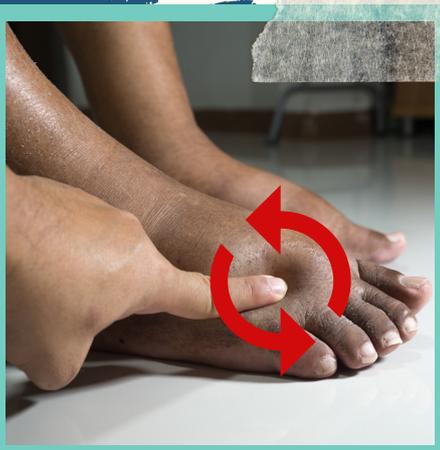


Evaluation of Charcot's Neuroarthropathy by the Nurse



When assessing the feet of a patient with DM, the nurse must pay attention to the warning signs (47-49):

- **Presence of hyperkeratosis;**
- **Deformities;**
- **Footwear;**
- **Presence of intermittent claudication;**
- **Previous infections and neuropathic symptoms;**
- **Complete assessment of ulcers, when present.**



Lower limb edema, which extends to the foot and around the affected joints;

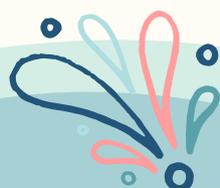


Erythema

Increased foot temperature (2°C more than the other foot);



Pain or lack of sensation



Attention



When a patient with DM without neuropathy presents foot swelling and increased temperature, CN should be suspected until proven otherwise (50).

People with foot swelling, associated or not with pain, aged 40 or over, obesity and neuropathy should be initially diagnosed with CN, until definitive confirmation (47).

The **temperature difference between the feet is a simple finding**, however, it is considered to be an evaluation parameter used worldwide. It is a cheap, easy and good clinical marker of the manifestation of the inflammatory process in the acute phase (51).

Early diagnosis of CN can be difficult and the presentation of signs of swelling and erythema can be neglected in the initial phase (5, 21), since they are confused with other conditions, such as skin infections (cellulitis and erysipelas), deep venous thrombosis, fracture, plantar fasciitis and osteomyelitis (22, 47).

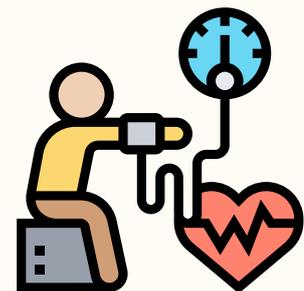
The **nurse has an important role in the evaluation of the patient**, with the clinical examination of the feet together with the survey of general health data, essential for the success of the treatment (52):



Glycemic control



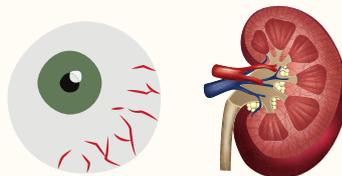
Surgical history



Cardiac alterations



Nutritional status



Ophthalmological and renal alterations



Medicines in use

Imaging exams are considered to support clinical diagnosis (49):

- Foot **radiography** can be normal, suffering alterations after three or four weeks;
- **Magnetic resonance imaging** is positive in the inflammatory phase;
- **Computed tomography** can be performed when there is a contraindication for resonance.

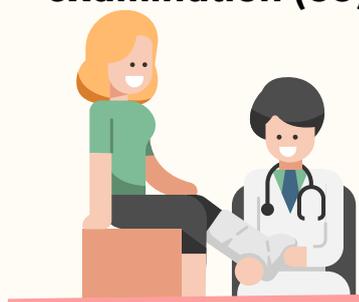


References: (24, 25, 27, 49).

! Attention!

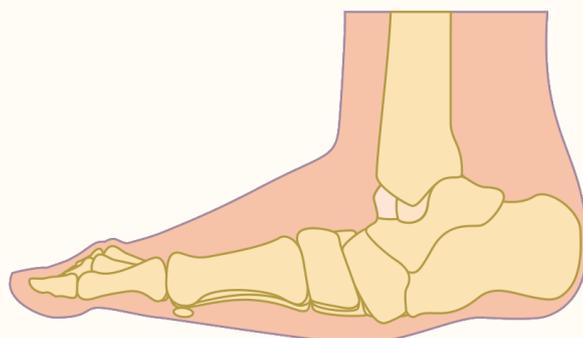


Do not ignore the most important diagnostic method: physical examination (53).



Knowledge of pathophysiology and physical examination is essential, since failure to diagnose and failure to institute treatment in the acute phase leads to severe deformities, with fractures and degeneration of the bones and joints of the feet, in addition to significant morbidity (24, 54).

In the **chronic phase**, the most common feature of foot deformity is degeneration of the midfoot (tarsometatarsal joint). Although it is the classic deformity due to the “rocker bottom” shape, this condition can reach other joints of the forefoot and ankle: talonavicular, calcaneocuboid, metatarsophalangeal and interphalangeal, talocrural and calcaneus (49, 55).



Adapted from: Boulton AJM et al. Comprehensive foot examination and risk assessment. Diabetes Care, v. 31, n. 8, 1679-85, 2008



Classification System:

After confirming the diagnosis of CN, using a classification system is useful to determine its phase, severity, location and complexity (34). The Eichenholtz Classification, which uses three clinical and radiological stages of progression, is the most widely used (29, 48, 49, 53, 54). Once a complete foot evaluation and CN classification have been performed, it is important to identify the deformities and the consequent increase in pressure points and define the treatment (20).

Eichenholtz classification

STAGES	RADIOLOGICAL FINDINGS	CLINICAL FINDINGS	TREATMENT
0 INFLAMMATORY	NORMAL RADIOGRAPHY	EDEMA, TEMPERATURE AND ERYTHEMA	MONITORING PROGRESSION, PROTECTED WEIGHT-BEARING AND PATIENT EDUCATION
I DEVELOPMENT	OSTEOPENIA, FRAGMENTATION, JOINT SUBLUXATION, OR DISPLACEMENT.	LIGAMENT LAXITY	OFFLOADING: TOTAL CONTACT CAST OR REMOVABLE CAST UNTIL RADIOGRAPHIC RESOLUTION OF THE FRAGMENTATION AND NORMAL TEMPERATURE (2 - 4 MONTHS)
II COALESCENCE	DEBRIS ABSORPTION, FUSION OF LARGE FRAGMENTS	DECREASED SIGNS OF EDEMA, TEMPERATURE AND ERYTHEMA	OFFLOADING
III RECONSTRUCTION	CONSOLIDATION OF DEFORMITY, JOINT ARTHROSIS, ROUNDING OF BONE FRAGMENTS	ABSENCE OF INFLAMMATORY SIGNS, INSTALLED DEFORMITY	CUSTOM SHOES WITH RIGID SHANK AND ROCKER BOTTOM SOLE. DEBRIDEMENT AND SURGICAL TREATMENT.

Adapted from: ROSENBAUM, A. J.; DIPRETA, J. A. Classifications in Brief: Eichenholtz Classification of Charcot Arthropathy. Clinical Orthopaedics and Related Research, v. 473, n. 3, p. 1168–1171, 2015.

Conservative treatment: ASAP!

The treatment of CN is divided according to its phases: acute phase and chronic phase, (29, 43).

Acute Phase Care:



1- Prevent the progression of foot deformity.



2- Promote the resolution of the inflammatory phase and reduce the treatment time;



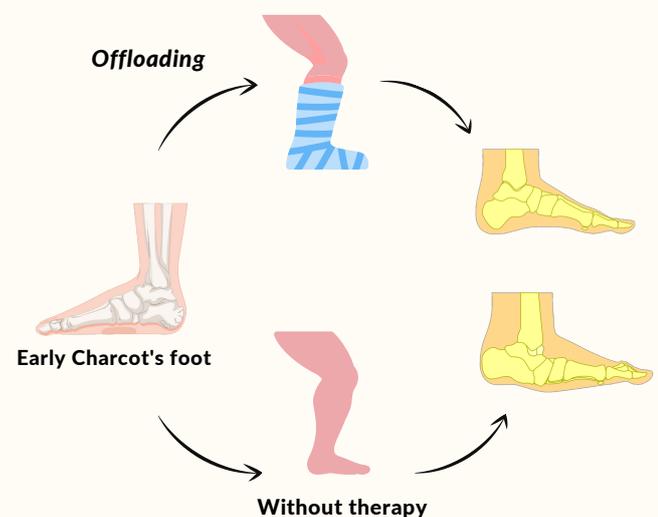
3- Prevent recurrence and future episodes.

In this phase, the basis of the treatment consists of immobilization for offloading in order to reduce the pressure area on the traumatized foot; offloading must be carried out as early and as often as possible (47, 55, 57). The immobilization will protect the foot from physical forces that can cause permanent bone and joint damage (29, 56, 57).

Total Contact Cast (TCC):

The immobilization method using total contact cast (TCC) is the one with the greatest evidence and is considered the gold standard for treatment (25, 55) since it increases the surface of the contact area on the foot, evenly distributing the pressure (47, 55, 56). The cast is not only indicated for patients with radiological changes, but for the initial stages that show normal radiography; the use of treatment can interrupt the development of the disease and foot deformities (25).

Total contact cast therapy:



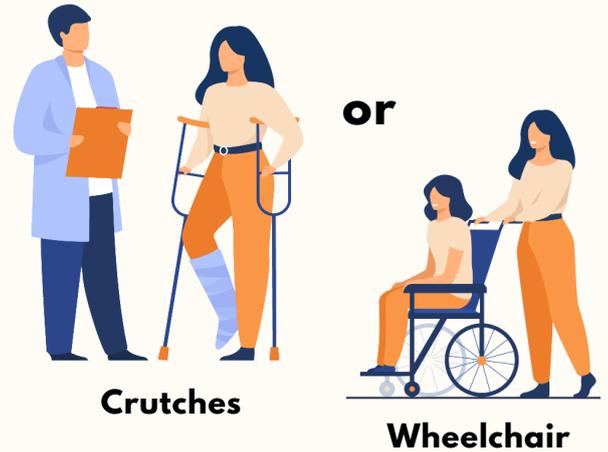
Adapted from: ROSSKOPF, A. B. et al. The Charcot foot: a pictorial review. Insights into Imaging, v. 10, n. 1, p. 1-13, 2019.

The patient using the TCC should be instructed to evaluate the cast daily and immediately report any structural problems such as cracks, in addition to controlling blood glucose and body temperature (58), the foot must be carefully evaluated throughout the treatment (56).

How long do I use the TCC for?

Initially, the TCC should be changed every 4 or 5 days, then weekly (59). It is important to note that the patient must use crutches or a wheelchair during the treatment to avoid weight offloading on the affected side (16, 47, 56, 57).

The clinical resolution of the CN will determine the total treatment time until the signs of swelling and the temperature of the foot are equal to the contralateral foot and the radiography shows evidence of bone healing. This period can vary between 12 and 18 weeks, on average (46, 59).



Contraindications of TCC:



Severe peripheral arterial disease



Infected ulcer



Excessive swelling References: (60, 61)

Difficulties in using the TCC:

Some patients have difficulties during the TCC treatment related to comorbidities, such as obesity and postural hypotension; visual acuity decreased by retinopathy; alterations in proprioception, which hinder the use of crutches, and difficulties in using a wheelchair due to the architecture of the non-adapted residence (56, 61, 62). There are also limitations on the part of professionals who must be trained to apply the TCC and the long application time of at least **30 minutes** (56).



Removable Cast:

The removable cast is an alternative treatment for professionals who do not have sufficient knowledge regarding the handling of TCC. In addition to being cheaper, it is also recommended for patients with significant swelling or infection (7). The treatment time can be longer and the patient must be instructed on its use since it can be removed and the patient can move around without it (56, 63).



Note: Images available on CANVA® for free.

Pharmacological Treatment:

The evidence on the pharmacological treatment of CN is limited and not very robust (55, 56). The indicated drugs regulate osteoclastic activity (48) and bisphosphonates show benefits when used together with immobilization (16, 48, 55, 56).



Care in the Chronic Phase:

After the resolution of the **acute phase**, such as swelling, foot temperature and the confirmation of bone consolidation by radiography, the patient should receive the following recommendations in the **chronic phase** (25):

- 1 Use of therapeutic footwear and insoles that accommodate foot deformities (63). Footwear should be used primarily for short periods with a gradual increase in wearing time; in between, the patient can use the removable device (25).



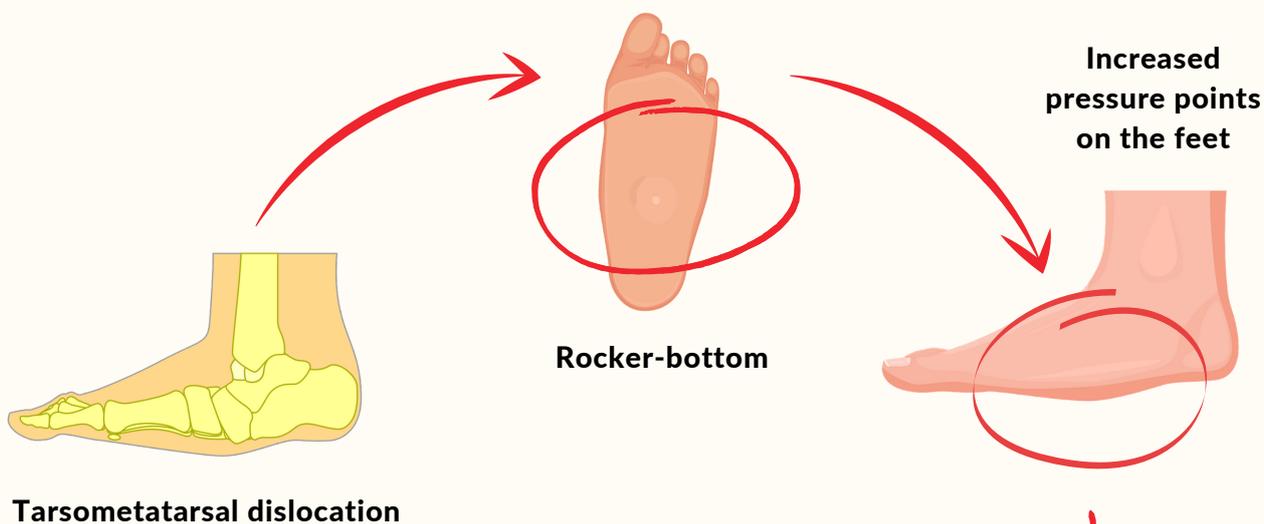
- 2 Patient education for daily foot evaluation, including measuring the temperature (56, 63). Involving the patient in self-care and explaining the risk of amputation is essential for adherence to treatment (64).

- 3 Monitoring by the multi-professional team (56).



- 4 Control of blood glucose levels (46).

The **clinical characteristics of the foot in the chronic phase** are perceived by joint deformities and sub-dislocation of the metatarsals, the rocker-bottom format, which causes increased pressure points on the feet, the formation of hyperkeratosis, and increased risk of ulceration (16, 20, 34).



Reconstructive surgery:

In the chronic phase of the disease, reconstructive surgery has shown good results (19), also when associated with adequate clinical treatment, returning functionality to the limb in the long term (65). The goal of any surgery is to reduce the deformity to improve the stability and alignment of the foot, eradicate osteomyelitis, and prevent complications and amputations, however, it is a high-risk procedure due to the various comorbidities that the patient may have (53, 55). The procedure can be from the least complex removing a bony prominence, to complex involving the entire structure of the foot and ankle, with the use of external and internal fixators (55).



Ulcer due to foot alterations caused by CN, secondary to DM. Images published with permission.

Final considerations

It is essential to recognize CN as a modifiable scenario based on the performance of the multi-professional team, the monitoring by a specialized nurse, and the engagement of the patient and his/her family in the treatment, on an outpatient basis. Actions like these can replace advanced and high-cost treatments with prevention programs or protocols, focusing mainly on comprehensive care.

In this context, the nurse has an important role in the evaluation and guidance regarding foot care based on the control of risk factors for the development of ulcerations.

Even over the decades, there are still many unanswered questions about CN, especially in relation to prevention. Future researches could benefit from an international consensus on a precise and universal nomenclature of CN, as well as definitions, classifications, treatments and indications.



Note: Images available on CANVA® for free.

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