



Northern Diabetes Foot Care Network

Multi- Disciplinary Foot Care Service

Active Charcot Foot Syndrome Guidelines

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Pathway of Clinical Care

Adapted from: Milne *et al.*: Developing an evidence-based clinical pathway for the assessment, diagnosis and management of Acute Charcot Neuro-arthropathy Syndrome: a systematic review. *Journal of Foot and Ankle Research* 2013 6:30.

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<http://www.nice.org.uk/guidance/ng19>

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Introduction

Charcot Foot Syndrome (CFS) is one of the more devastating complications affecting patients with diabetes and peripheral neuropathy. It is a progressive, destructive condition that is characterised by acute fractures, dislocations and joint destruction in the weight-bearing neuropathic foot. The active phase is often misdiagnosed and can rapidly lead to severe foot deformity, ulceration and amputation. Early diagnosis and management of active CFS is therefore imperative to avoid the rapid progression towards permanent foot deformation and its associated complications.

The occurrence of Charcot Foot Syndrome is associated with a mean reduction in life expectancy of 14 years. The main aspect of long term care lies in making every effort to reduce long term mortality and because of the evidence that neuropathy itself is a cardiovascular risk factor survival can be improved by the rigorous implementation of measures to reduce cardiovascular risk.

The pathway aims to support multi-disciplinary foot care services throughout the North of England Foot Care Network in making as early a diagnosis and providing appropriate immediate management of active Charcot Foot Syndrome. Immediate best practice management of this devastating complication is vital to improve clinical outcomes and patient quality of life.

The pathway is divided into two parts incorporating the four key phases for the clinical management of active CFS.

ACTIVE CFS PATHWAY OF CLINICAL CARE ASSESSMENT: 1) Assessment including immediate immobilisation 2) Investigations 3) Diagnosis.

ACTIVE CFS PATHWAY OF CLINICAL CARE MANAGEMENT: 4) Management of Active CFS and long term management of confirmed inactive Charcot.

It should be noted that whilst the pathway is there to assist clinician evidence based decision-making, clinical discretion is still required.

ACTIVE CHARCOT FOOT SYNDROME PATHWAY OF CLINICAL CARE ASSESSMENT

PATIENT PRESENTS WITH UNEXPLAINED HOT, RED, SWOLLEN FOOT

Clinical signs / symptoms:

- Usually localised unilateral swelling
- Erythema
- Warmth
- +/- Pain (50%)
- +/- Deformity

Clinical assessments:

- Peripheral neuropathy (unable to detect 10g monofilament)
- Normal peripheral arterial perfusion: Pulses evident by palpation or with Doppler ultrasound (where obscured by concurrent oedema)
- Infrared dermal thermography comparisons $> 2.0^{\circ}\text{C}$ between contra-lateral corresponding locations *using infrared dermal thermometer accurate to $\pm 0.1^{\circ}\text{C}$*
- History of trauma (25% of cases) or surgery
- Longstanding Diabetes (85% > 10 years duration)
- **Charcot Risk Group**

Immediate clinical management:

Immediate immobilisation

- Total Contact Cast (TCC)
- Irremovable walker (i-TCC) with offloading insole or
- Removeable walker with offloading insole (*only* if TCC or i-TCC are deemed inappropriate)

Considerations: Ulcer, infection, deformity, falls risk, frequency of reviews and / or poor adherence

Imaging referrals: Weight bearing x-ray

ACTIVE CHARCOT FOOT SYNDROME CONFIRMED?

YES

On the basis of:

- **Clinical signs/symptoms and**
- **$> 2^{\circ}\text{C}$ temperature difference at corresponding locations**
- +/- Hx
- +/- Conclusive diagnostic imaging findings (*Bony consolidation, fragmentation of subchondral bone, fractures, dislocation / subluxation, osteopenia, osteolysis*)

NO

Clinical Diagnosis inconclusive and x-ray normal:

- *Continue with immobilisation management until a definitive diagnosis is made or clinical symptoms resolved*
- **Mandatory MRI for diagnostic purposes**
- Further diagnostic investigations maybe required to exclude other possible causes :

Potential ddx:

- Infection (osteomyelitis, cellulitis, abscess, deep tissue infection) - **In the absence of elevated systemic inflammatory markers, infection may be an unlikely diagnosis and acute CN should be considered.**
- Neuropathic / traumatic fracture
- **Sprain**
- DVT > refer for duplex vein scan
- Acute gout
- Inflammatory arthritis

CONFIRMED ACTIVE CHARCOT FOOT SYNDROME PATHWAY OF CLINICAL CARE MANAGEMENT

Management

- **MRI for full confirmation of diagnosis (if x-ray normal)**
- Continue immobilisation
 - Initial TCC to be removed and re-casted after 3/7 due to significant reduction in swelling
- Education
- **Emotional support / Psychology input**
- Ensure contra-lateral footwear is appropriate with offloading insole to prevent bi-lateral Charcot
- Review 1-2/52 to:
 - Re-assess infrared dermal temperatures
 - Re-cast TCC / re-assess walker fit



Average management time: 2 – 12 months



Foot remains unstable and / or non-responsive to immobilisation

- Referral to orthopaedics for surgical review
- **Urgent Referral for new ankle disarticulation**



Confirmed inactive Charcot dx:

Clinical signs / symptoms completely resolved

+

< 2⁰C temperature difference at corresponding locations for 4 - 6 consecutive weeks

+

Weight bearing x-ray confirming remodeling phase and to assess chronic deformity



Long- term management

- Gradual step down to partial weight bearing as required
- Footwear offloading
 - **Nil deformity:** Appropriate footwear + offloading orthotics
 - **Moderate deformity:** Custom footwear + offloading orthotics
 - **Severe Deformity ± rearfoot or ankle Charcot:** CROW ± referral to orthopaedics for surgical review
- Education
- **Emotional support / Psychology input**
- Physiotherapy referral for muscle strengthening
- 3 monthly reviews to monitor reactivation of Active CFS

ACUTE CHARCOT PATHWAY OF CLINICAL CARE ASSESSMENT

1. Assessment

➤ Clinical signs & symptoms

It is well reported that active CFS characteristically presents with localised swelling, erythema and increased temperature ($>2^{\circ}\text{C}$ compared to the contralateral foot) to the affected foot. Owing to the presence of peripheral neuropathy, pain may not always be present (reportedly in only 50% of cases) or will be less than expected given the severity of the clinical findings. The diagnosis of active CFS is primarily dependant on this initial clinical presentation and therefore requires high clinical suspicion by the treating clinician for all patients with diabetes and peripheral neuropathy or renal failure who present with these clinical signs and symptoms. More advanced presentations of active CFS may also present with obvious foot deformity, including the characteristic 'rocker-bottom' deformity that is emblematic of CFS.

To confirm the diagnosis of Charcot arthropathy, refer the person within 1 working day to the multidisciplinary foot service for triage within 1 further working day. Offer non-weight bearing treatment until definitive treatment can be started by the multidisciplinary foot care service. NICE NG 19 (2015)

➤ Clinical assessments

- **Peripheral neuropathy:** The presence of peripheral sensory neuropathy is an important component for the onset of active CFS, **neuropathy being clinically apparent in the majority but not all cases of CFS.** Peripheral sensory neuropathy can be accurately assessed using a 10 g monofilament.
- **Normal peripheral arterial perfusion:** Generally, the active CFS foot has well preserved arterial perfusion. **Pedal pulses are usually palpable (sometimes abnormally so because of AV shunting) unless obscured by associated swelling.** In this instance, the use of a doppler ultrasound may be required to assess arterial perfusion.
- **Infrared dermal thermometry comparisons $>2^{\circ}\text{C}$:** Temperature monitoring with the use of a handheld infrared dermal thermometer is a useful diagnostic assessment tool. Infrared dermal thermometry comparisons between contralateral corresponding locations are typically $>2.0^{\circ}\text{C}$ in the affected foot. Temperatures should be assessed approximately 15 minutes after the cast and footwear is removed and the use of an infrared dermal thermometer precise to $\pm 0.1^{\circ}\text{C}$ for a more accurate assessment is recommended. Most frequently recommended skin temperature testing sites are: dorsal mid foot, hallux, medial 1st metatarsal head, plantar 3rd metatarsal head, lateral 5th metatarsal head, 1st metatarsal-cuneiform joint, talonavicular joint, cuboid, plantar heel, and ankle .
- **History of trauma (25-50%):** Preceding trauma may be recalled in as many as half of all cases of active charcot foot syndrome. The role of trauma in an insensate extremity has been reported as an important factor in the pathogenesis of active CFS and should therefore be queried at the initial presentation. In incidences where no trauma is recalled, repetitive micro-trauma on an insensate foot may be a contributing factor. Recent foot surgery has also been described as a possible precipitating factor to active CFS . The precise mechanisms by which surgery affects the pathogenesis of CFS remain unclear.
- **Long-standing diabetes:** Most commonly, at the time of onset patients with both Type 1 or Type 2 diabetes have been diagnosed for a period >10 years .

- **Charcot Risk Groups:** Certain risk groups are more susceptible to developing Charcot Foot Syndrome including previous contralateral Charcot, combined kidney / pancreas transplant and patients with peripheral neuropathy. It is worth noting peripheral neuropathy can result from diverse conditions including chronic alcoholism.

Immediate clinical management

Immediate immobilisation: if active CFS is suspected, immediate immobilisation should be implemented until a definitive diagnosis is determined. Options for immobilisation include the total contact cast or irremovable/removable walkers.

Total contact casts and irremovable walkers: originally referred to as the 'gold standard' immobilisation therapy for active CFS, due to their custom and irremovable nature. The TCC immobilises the affected foot and ankle, reduces plantar foot pressures and swelling, protects from additional trauma, and maintains patient mobility. The instant total contact cast (iTCC) which has been reported to be just as effective in immobilising the Active CFS foot. An iTCC consists of a prefabricated removable walker that is rendered irremovable by simply applying a layer of tape or fibreglass cast roll around the body of the walker to encourage patient compliance. Removable walkers: Prefabricated removable cast walkers have the benefit of immediate application without specialist skills and have been reported to be just as effective in offloading the diabetic foot; however patient adherence is often significantly reduced with these devices. As a result, removable walkers should only be prescribed when TCCs or iTCCs are deemed inappropriate.

If the multidisciplinary feet care service suspects Charcot arthropathy offer treatment with a non-removable offloading device. If a non-removable device is not advisable because of the clinical, or the person's, circumstances, consider treatment with a removable offloading device. NICE NG 19 (2015)

2. Investigations

- **Imaging referrals**

- **Plain weight bearing radiographs:** If a patient presents with localised unilateral swelling, erythema and increased temperature in an insensate foot, plain radiographs are an important first line investigation and can be invaluable in ascertaining the presence of CFS. In most cases, no further imaging studies are required to confirm diagnosis. Weight-bearing radiographs without immobilisation can be valuable in identifying subtle fractures, fragmentations and joint subluxation seen in very early stages of active CFS, which may not be present on standard non-weight bearing films. Additionally, joint deformity or collapse is often more accurately assessed in weight bearing views.
- **Magnetic resonance imaging:** represents a non-invasive and sensitive diagnostic tool in the study of bone marrow and soft tissue abnormalities providing high quality images of the foot. MRI has the ability to detect subtle changes in the early stages of active CFS, such as bone marrow oedema, before they are evident on plain radiographs. This can play an important role in the early diagnosis of active CFS, when radiographs are inconclusive, thereby improving clinical outcomes. Where available and appropriate for use, MRI should be the imaging modality of choice for the diagnosis of active CFS when radiographs are inconclusive.

If acute Charcot arthropathy is suspected, arrange a weight bearing X-ray of the affected foot and ankle. Consider MRI if the X-ray is normal but Charcot arthropathy is still suspected. NICE NG 19 (2015)

- **Serology referrals**

There is currently no universally accepted serology criterion for the diagnosis of CFS; however, some studies have reported that serology markers may assist in narrowing the diagnosis

Inflammatory markers: Leukocytosis (WCC), an elevated C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR), and recent unexplained hyperglycaemia are all systemic responses to infection. It should be noted that CRP can be slightly elevated in acute Charcot and Charcot and infection can both co-exist in the same foot

In the absence of elevated systemic inflammatory markers, infection may be an unlikely diagnosis and active CFS should be considered.

- **Glycated haemoglobin:** Inactive hyperglycaemia is a major incipient factor in the development of CFS. As part of a multidisciplinary approach to the management of a patient with diabetes and suspected CFS, it is recommended the HbA1c be assessed and, where necessary, optimised].
- **Uric acid:** Acute gout attack may also masquerade as active CFS. However recent studies suggest that one third of patients with acute gouty arthritis have normal urate levels - the level of uric acid in the blood cannot be reliably used to make a diagnosis of gout. As such differential diagnosis should be based upon clinical suspicion (Mono-arthritis, 1st metatarsophalangeal joint – podagra), plain radiograph & MRI

3. Diagnosis

- **Active CFS diagnosis criteria**

The most commonly accepted criteria by treating clinicians for the diagnosis of active CFS is: a warm, swollen, erythematous foot (clinical signs), with or without any significant history of trauma or surgery, a temperature difference from the contralateral foot of > 2°C, and conclusive diagnostic images suggestive of active CFS. In the presence of a wound or history of osteomyelitis, clinical suspicion and assessment of osteomyelitis should be considered.

- **Negative diagnosis**

In the event that CFS may not be the most likely diagnosis, experts in the field recommend continuing with immobilisation until a definitive diagnosis is made so that the risk of foot deformity or other associated complications can be avoided if in fact CFS is later diagnosed.

- **Differential diagnosis**

Historically, misdiagnoses for active CFS have included infection (osteomyelitis, cellulitis, abscess, and deep tissue infection), DVT, acute gout, neuropathic/traumatic fractures, sprain, or inflammatory arthritis. Given its rare presentation, it is not surprising that a large number of cases of active CFS are initially misdiagnosed; however, this only further emphasises the need for high clinical suspicion when a patient with diabetes and neuropathy presents with the clinical signs and symptoms suggestive of active CFS.

ACTIVE CHARCOT PATHWAY OF CLINICAL CARE MANAGEMENT

4. Management

- **Active management**

- Continue immobilisation until complete resolution of the active phase. The cast is initially replaced (TCC) or re-fit (iTCC, removable walker) after the first 3 days due to the significant oedema reduction seen after this period. The cast is then replaced 1-2 weekly after this time, again to adjust for limb volume changes from oedema and to assess for any complications secondary to immobilisation.
- **Education:** Patient education regarding the diagnosis, estimated length of treatment and expected outcomes is an important component of CFS management. If the patient understands the nature of this limb-threatening condition, they may be more motivated to adhere to the management plan. Emphasise the importance of strict immobilisation, attending regular follow-up reviews and optimising glucose control may improve the outcome of CFS.
- **Emotional support / Psychology input:** **Anxiety and depression problems are more severe and more common in diabetes patients with Charcot Foot Syndrome. Clinician awareness of the high risk of anxiety and depression in these mostly older and vulnerable adults should guide appropriate screening and care planning which may include access to ongoing psychological support, hopefully resulting in better outcomes.**

Appropriate contralateral footwear: Bilateral CFS is reported in as many as 30% of cases. Immobilisation therapy, especially with the use of crutches, has been reported to potentially increase the load on the contralateral foot and thereby predispose the patient to bilateral active CFS. For this reason, prophylactic support with appropriate footwear and accommodative insoles is recommended for the contralateral foot **which may help** to minimise the risk of bilateral active CFS. **It is also important to ensure the contralateral foot is protected from rubbing from the cast in bed.**

- **Regular reviews:** During the immobilisation period, regular reviews by the multidisciplinary foot service are important to monitor the activity of the Active phase, review the management plan, and assess and manage any secondary complications. Measuring skin temperature differences between the affected and the non-affected foot using an infrared dermal thermometer is an objective measure for monitoring reduction in inflammation during the active phase of CFS. TCC's should be re-casted and the fit of walkers re-assessed at 1-2 weekly reviews to adjust to limb volume changes as the oedema subsides during immobilisation .
- **Periodic follow-up radiographs:** Following the initial diagnosis, follow-up radiographs of the affected foot will monitor the progression of CFS, as well as any changes in the architectural alignment and configuration of the foot. However, given the paucity of empirical evidence recommending the benefit of periodic follow-up radiographs the **Northern Diabetes Foot Care Network advises these are only performed when further damage or osteomyelitis is suspected.**

Monitor the treatment of acute Charcot arthropathy using clinical assessment. This should include measuring foot-skin temperature difference and taking serial X-rays until the acute Charcot arthropathy resolves. Acute Charcot arthropathy is likely to resolve when there is a sustained temperature difference of less than 2 degrees between both feet and when X-ray changes show no further progression. NICE NG 19 (2015)

- **Inactive CFS**

The duration of immobilisation is guided by the clinical assessment that the active phase has completely resolved. This is evident by the resolution of all clinical signs and symptoms, stabilised contralateral skin temperatures, and evidence of healing on radiographs. Previous studies have recommended a skin temperature difference between contralateral locations of $<2^{\circ}\text{C}$ for 2-4 consecutive weeks before transitioning patients from

cast immobilisation to a removable walker or appropriate footwear. Radiographs are an important tool in assisting in the diagnosis of inactive CFS and are recommended once all clinical signs and symptoms have resolved. Radiographic evidence of inactive CFS includes healed fractures, sclerosis of bone, absorption of bony debris, fusion and rounding of large fragments, and increased bone density. Feet with severe CFS deformity are significantly associated with midfoot ulceration. Therefore, weight bearing radiographs of inactive CFS may be more beneficial at this time to assess the presence and degree of deformity so that appropriate long term offloading can be prescribed.

Long-term management

- **Partial weight bearing:** Once the foot is stable, transition to protected weight bearing is generally advised before the patient steps down to footwear. Aircast walkers or other similar prefabricated removable walkers have gained acceptance as useful protective modalities for this initial period of weight bearing. Partial weight bearing has been reported to minimise the risk of reactivation of the Active phase if immobilisation is ceased too early.
- **Footwear and offloading:** Footwear is an important component of the long-term management of the insensate inactive CFS foot, ensuring that it remains accommodated, offloaded and protected.
 - **Patients with nil to minor foot deformity:** after the resolution of active CFS, prefabricated footwear with extra depth and a stiff rocker bottom walking sole may suffice. These shoes, when fitted with custom-moulded, full-contact insoles, will adequately minimise load bearing and mobility of the foot during walking.
 - **In the presence of moderate deformity:** custom-made or modified shoes are generally necessary to accommodate the inactive foot deformity. Again, these shoes should be fitted with custom-moulded, full contact insoles to minimise load bearing and mobility during walking
 - **Inactive CFS that has resulted in severe foot deformities and/or CFS that is located in the ankle or rear foot:** can often be difficult to stabilise with footwear and typically requires more aggressive long term management such as a Charcot Restraint Orthotic Walker (CROW) to achieve stability and reduce the risk of reactivating the active phase. The CROW has proven to be useful in maintaining foot and ankle alignment in the instable or surgically corrected CFS foot however, where aggressive conservative management has failed, surgical correction of the deformity should be considered.
- **Education:** Patient education should form an essential component of the long-term management of these patients, focusing on the importance of appropriate footwear and offloading, regular follow up reviews, and the risk of further complications.
- **Rehabilitation:** Following an extended period of immobilisation, there will likely be wasting of the calf muscles, loss of bone density and joint stiffness. Protective rehabilitation with a physiotherapist is recommended following the transition phase out of immobilisation, being cautious, however, of the risk of reactivation of the active phase or ulceration of bony deformity by excessive rapid mobilisation during the early stages of rehabilitation.

Long term follow up

- **Reviews:** Three monthly podiatry reviews of these high-risk patients is advised to monitor for signs of recurrent or new episodes of CFS, as well as any other diabetic foot complications. Recurrence is reported in 15-30% of patients with a previous history of CFS.
- **Surgical:** Typically, if the correct diagnosis is made in the active phase of CFS and conservative treatment is successful, surgery may be avoided and the risk of subsequent ulcerations and/or amputation may be decreased. Surgical management is usually only considered in the inactive phase of CFS where joint instability and/or severe deformity have failed to be effectively managed with a conservative approach. Surgery is generally avoided during the active phase of CFS due to the risk of mechanical failure or secondary infection.