Diabetic Osteoarthropathy Care
- Still a Need for Improvement

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Abstract
Although the Charcot foot has been known for close to 150 years, diabetic osteoarthropathy is still an enigmatic and probably not seldomly overlooked diagnosis that can affect the diabetic foot. To keep it among one’s potential differential diagnosis is of utmost importance when dealing with patients with diabetes mellitus and foot problems. We present two cases unfortunately not atypical regarding the care of this group of patients in the 21st century. We suggest that this diagnosis need to be emphasized and further investigated, not only the pathogenesis, but also how to ideally manage it in a clinical setting. These two cases illustrate well the need for an improved awareness of diabetic osteoarthropathy and for guidelines to follow, when the condition is encountered. The cases also emphasize the value a multidisciplinary diabetic foot-team.

ABBREVIATIONS
DO: Diabetic Osteoarthropathy; DVT: Deep Venous Thrombosis; TCC: Total Contact Cast

INTRODUCTION
Neuroarthropathy is a condition originally described by Charcot in 1868 and related to neuropathy from lues [1]. Although today osteoarthropathy is observed in patients both with acquired and hereditary sensoric neuropathy, neuropathy in patients with diabetes mellitus constitute the overwhelming majority of osteoarthropathy cases [1]. Charcot-foot is therefore often used as a synonym to diabetic osteoarthropathy (DO) [3]. The prevalence of DO among patients with diabetes mellitus has not been comprehensively investigated but varies between 0, 8-8 % in the studies presented [4-5]. Although the condition has been known for a considerable time, diagnosis and treatment remain at a suboptimal level [6]. Though the condition is rare it is devastating to those who acquire it. The most commonly affected area is the mid foot and a collapse here result in plantar deformity, recurrent ulcers, infections and in the end a high risk of amputation [7]. In recent years the interest and research activity regarding DO has substantially increased and the two, established, main theories regarding the pathogenesis has met with competition. Originating in Germany the neurotraumatic explanation postulates that repetitive micro traumas form the basis of the collapse. The other, French, theory (advocated by Charcot himself) states that the condition is neurovascular mediated. Due to autonomic neuropathy the tonus of the vessel walls are disturbed which leads to hyperemia which in turn increases bone resorption [8]. The more recent theory focus on the role of pro-inflammatory cytokines, in particular the receptor activator of the nuclear factor-κB (RANK) ligand (RANKL) system in relation to bone metabolism, the osteoblast/osteoclast-balance [9,10].

Regardless of the underlying mechanisms, early diagnosis is paramount to a successful outcome and optimal treatment, where the patient can preserve the foot anatomy and go back to normal physical activity without the need to resort to amputation. The following two case-reports illustrate how difficult it can be, even today, to diagnose the condition and the consequences that come from failing in doing so.

CASE PRESENTATION
Case 1
34-year old male with six years duration of type 1 diabetes mellitus. He woke up one morning with a swollen and red left lower leg. He could not recall any trauma. A day later he pays a visit to the emergency department of a university hospital. He there presents with fever (38,3) and a swollen left lower leg with no apparent, but slight, redness. CRP is 233, D-dimer 0,51, leukocytes 10,9, glucose 20,8. A reduced sensibility in the feet is noted. The preliminary diagnosis is erysipelas with deep venous thrombosis (DVT) as an alternative diagnosis. He is admitted to

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• Diabetic foot surgery

the hospital overnight, where he receives intravenous antibiotic treatment. Ultrasound does not support the diagnosis of DVT and the patient is released with oral antibiotics. The patient returns in a week to the emergency department with a subjective reduction of redness but no difference regarding the swallowing of the foot. The diagnosis of erysipelas is maintained and a change of oral antibiotics is made. After another ten days the patient meets his GP (general practitioner) who refer him to the multidisciplinary diabetic foot-team at the university hospital for an opinion of the patient’s foot. He is planned for a visit 12 days later. The differential diagnosis of DO is considered, X-ray is performed the same day, confirming the diagnosis, and treatment is initiated with a total contact cast (TCC) offloading (Figure 1,2).

After 10 months of cast and offloading, the DO is deemed to have resided and the patient is allowed to use orthopaedic shoes and a crutch. At this stage plans were made for extensive reconstructive surgery, however the patient develops an infected wound and therefore the surgery is delayed. 1 1/2 years after the initial diagnosis the surgical plan is revised to only incorporate a removal of bone protrusion of the lateral malleolus, which is performed close to two years after diagnosis. The patient is overall satisfied with this surgery and can walk on the foot without any pain and is able to return to his work part time in the retail business (Figure 3,4).

Case 2

55-year old male with type 1 diabetes mellitus diagnosed at the age of 15 and with kidney insufficiency due to the disease. He is physically active racing cars and performing outdoor sports such as hunting. During a hunting trip abroad a sudden swallowing and redness of the right lower leg appears. He cannot recall any specific trauma, though he has been walking a lot during the hunting trip. After returning from abroad, with an eight day history of foot problems since the debut, he visits the emergency department of a regional hospital where a pronounced swallowing of the right thigh and foot is noted. No remark is made regarding the color. The patient does not present with fever, the CRP is reported to be slightly raised and d-dimer normal. The preliminary diagnosis is DVT and the patient returns the following day for an ultrasonography. Differential diagnosis is a ruptured Baker cyst. The ultrasonographic examination does not confirm the DVT diagnosis and he is sent back home with a diagnosis of a ruptured Baker cyst. According to the patient he suggested an x-ray but due to the fact that there was no real trauma prior to the symptoms, this was deemed unnecessary. Two weeks later the patient himself contacted the multidisciplinary diabetic foot-team at the same hospital where he earlier had been a patient and went there the following day. He reported that something had happened with the foot and that it seemed even worse compared to 2 weeks earlier, when he visited the hospital. A swollen and red foot was noted, as well as a temperature difference between the feet of three degrees. A plain x-ray was performed. This showed dislocation in Lisfranc’s joint and a fracture of the second metatarsal bone of the right foot. The diagnosis of DO was considered confirmed and the
patient received a total contact cast (TCC) and a regimen of strict off-loading (Figure 5,6).

After 6 months of off-loading, the first month with a TCC and the following months with an orthosis due to the need to control the skin where some ulcers had appeared, the DO was considered inactive. Reconstructive surgery was then performed. With a wedge arthrodesis of the mid foot it was possible to reconstruct the medial ray. Laterally and medially, plates were used. In the second and third Metatarsophalangeal joints K-wires were used for the arthrodesis (Figure 7).

Postoperatively the patient was initially equipped with a total contact cast, which was replaced with an orthosis to be able to better follow the healing of the skin. A complete healing of the skin was accomplished after close to six months. A strict offloading regimen was prescribed but not completely adhered to. After six months, bone healing was visible on computer tomography scans and at this point the patient had begun to use shoes without any offloading. During these period oral antibiotics was prescribed, due to slow healing of the earlier mentioned foot ulcer together with the presence of Enterobacter in culture from the skin incisions.

After ten antibiotic free weeks, and returning back to work with full use of his foot, the patient is admitted with a plantar infection, caused by the protrusion of the basis of the metatarsal bones, mainly the third. This protrusion had caused the formation of a clavus and thereby providing an entrance for Staphylococcus aureus bacteria. The ulcer is debrided and a new period of offloading follows including antibiotic treatment. This time the wound is closed within three months. A three week period without antibiotics did not result in CRP-elevation or clinical deterioration, rather the contrary with less clavus-formation due to the offloading. The plan is then to resect the bony protrusions of the sunken TMT-joints, thereby hopefully minimizing the risk of recurrent infections. However, two weeks prior to this planned surgery, the patient is admitted with an infection of the fifth toe. This toe is deemed unsalvageable and toe amputation is therefore performed. Providing that this new postoperative wound heals and the infection is considered treated, surgery for removal of the protrusions will once again be planned. Hopefully this will lead to a functional foot, with the use of insoles and proper footwear.

**DISCUSSION**

Though it is easy to be critical in hindsight to decisions made, it is difficult not to reflect that a lack of knowledge of diabetic osteoarthropathy is the reason that this diagnosis is not included in the primary evaluations of these 2 patients. Likewise it is difficult not to think that had osteoarthropathy been a differential diagnosis when the patients first presented their symptoms, they may very well have been in another and better position today as discussed in a recent Irish publication [11].

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**Figure 4** 55-year old male with type 1 diabetes mellitus.

**Figure 5** After 6 months of off-loading.

**Figure 6** After 6 months of off-loading.

**Figure 7** The second and third Metatarsophalangeal joints K-wires.
In the second case it seems quite likely that the deterioration of the foot began after the visit to the emergency department and could have been avoided, had the patient received a total contact cast and a total offloading regimen at this point. The problem seems to be a lack of knowledge of the condition and a deficiency in guidelines how to act when suspecting diabetic osteoarthropathy. A situation recently presented in two studies (Denmark och USA) [12,13]. The lack of standards and guidelines to follow is also confirmed in a survey-study performed on a national level in all orthopaedic clinics of Sweden [14]. To the suffering for the patients of this long lasting and devastating diabetes complication we should add the substantial costs for the society [15]. In a modern value based medical care of complications to endemic diseases there is certainly a need for improvement in the care of diabetic osteoarthropathy [16]. This will result in less suffering for the patients and reduced costs for the society and should therefore have the highest priority. These case-reports also clearly highlights the importance and value of the concept of a multi-disciplinary diabetic foot-team including a dialectologist, a specialist in infectious diseases, an orthopaedic specialist focused on foot surgery, a chiropodist, an orthopedic engineer and access to a vascular surgeon [17-18].

REFERENCES