The management of Charcot joint disease affecting the ankle and foot by arthrodesis controlled by an Ilizarov frame

EARLY RESULTS

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Charcot osteoarthropathy of the foot is a chronic and progressive disease of bone and joint associated with a risk of amputation. The main problems encountered in this process are osteopenia, fragmentation of the bones of the foot and ankle, joint subluxation or even dislocation, ulceration of the skin and the development of deep sepsis. We report our experience of a series of 20 patients with Charcot osteoarthropathy of the foot and ankle treated with an Ilizarov external fixator. The mean age of the group was 30 years (21 to 50). Diabetes mellitus was the underlying cause in 18 patients. Five had chronic ulcers involving the foot and ankle. Each patient had an open lengthening of the tendo Achillis with excision of all necrotic and loose bone from the ankle, subtalar and midtarsal joints when needed. The resulting defect was packed with corticocancellous bone graft harvested from the iliac crest and an Ilizarov external fixator was applied. Arthrodesis was achieved after a mean of 18 weeks (15 to 20), with healing of the skin ulcers. Pin track infection was not uncommon, but no frame had to be removed before the arthrodesis was sound.

Every patient was able to resume wearing regular shoes after a mean of 26.5 weeks (20 to 45).
evident radiological deformity. In stage III (the healing stage), the foot and ankle are swollen, deformed and painless. Shibata, Tada and Hashizume\textsuperscript{10} added a stage 0 acute phase in which there was absence of any radiological evidence of a Charcot foot.

Conservative or operative treatment can be used depending on the situation at the time of presentation. After early recognition and diagnosis in the acute stage, a Charcot foot and ankle can be managed by immobilisation in a total contact cast for a prolonged period to protect the soft tissues by reducing the load on the ulcer and supporting the foot and ankle.\textsuperscript{11} However, this may result in an extended time in a cast with resolved cases showing gross deformity and risk of further ulceration.

Surgery may be undertaken in patients with Charcot joint disease of the foot and ankle to debride necrotic tissue, or to restore the alignment and stability of the foot and ankle. Procedures may include lengthening of the tendo Achillis, hindfoot osteotomy and arthrodesis using internal or external fixation.

We present the results of using Ilizarov external fixation to treat Charcot arthropathy of the foot and ankle.

**Patients and Methods**

Between 2004 and 2007, we treated 20 patients with stage-II Charcot arthropathy of the foot and ankle. There were 11 men and nine women with a mean age of 30 years (21 to 50). The right side was involved in 12. Diabetes mellitus was the major underlying cause: eight patients had type-I diabetes mellitus and ten type-II. One patient had leprosy and in one there was no apparent cause. All the patients presented with a deformed swollen warm erythematous foot and ankle. A total of ten patients had previously been treated by the application of a long-leg cast for more than 12 weeks without any improvement in their ability to walk. There were five patients with chronically infected ulcers on the foot and ankle: two had grade-I ulcers on the plantar aspect of the foot and three grade-2 ulcers on the lateral side of ankle due to varus deformity and subluxation (Table I). No patient had a history of major trauma to the foot and ankle. Radiographs of the foot and ankle showed bone resorption, intra-articular fractures, osteochondral fragmentation and formation of periarticular debris. Subluxation and joint deformities were present in 14 patients of whom 13 had an equinovarus deformity of the ankle: six had an associated adduction or varus deformity of the ankle at the level of the forefoot. One patient had an equinovalgus deformity at the ankle without deformity of the foot.

In addition to clinical and radiological evaluation, Doppler ultrasonography was used to assess the vascularity of the foot.

**Operative technique.** All operations were carried out under general or spinal anaesthesia with a pneumatic tourniquet. Pre-operative prophylactic broad-spectrum antibiotics were given. Cephalosporin was usually started within one hour before surgery at a dose of 1 gm and continued for another three days twice daily. Oral quinolone antibiotic tablets (500 mg) were then taken for ten days twice daily. The leg and foot were prepared and draped in the usual manner and the iliac crest prepared as a donor site for the bone graft. The tendo Achillis was lengthened through a
During the first three post-operative days, the foot and ankle were observed for swelling, vascularity and temperature. Gradual compression between the tibia and foot frames was applied at rate of 1 mm/day until complete compression was achieved between the arthrodesed surfaces. Restricted weight-bearing was allowed for a mean of ten weeks, after which unrestricted weight-bearing was undertaken.

The patients were reviewed weekly for the first two weeks, then every two weeks for the following months until the removal of the Ilizarov frame after which a below-knee plaster cast was applied.

**Results**

The mean follow-up was for 20 months (12 to 30) and no patient was lost to follow-up. Early superficial infection was encountered in two patients who were managed successfully by the administration of parenteral antibiotics. No early or late vascular complications ensued. Pin track infection occurred in 15 patients and was managed by treatment with local topical antibiotics and pin-site care. Persistent oedema and pain occurred in two patients. Skin ulceration healed completely within four to six weeks. No post-operative recurrence of ulceration was recorded. Arthrodesis occurred at a mean of 18 weeks (15 to 20) with a dynamisation period of a mean 3.5 weeks (3 to 4) (Fig. 2). The mean post-operative period in a below-knee plaster cast was five weeks (4 to 6). The mean total treatment period was 26.5 weeks (20 to 29).

The mean period of restricted weight-bearing was ten weeks (6 to 15) with a mean duration of unrestricted weight-bearing of 18 weeks (12 to 31). The mean time for patients to return to wearing regular shoes was 26.5 weeks (20 to 45). Shortening of the leg below the knee occurred in six patients with a mean reduction of 2 cm (1.5 to 2.5), while the remaining 14 patients had no leg-length discrepancy. Solid union and correction of deformity were achieved in all patients.

**Discussion**

A major problem in patients with chronic diabetes mellitus is the development of peripheral neuropathy. Sensory loss leads to neuropathic ulceration which is aggravated in the presence of foot and ankle deformity and causes excessive pressure on deformed areas. The major aim in treating Charcot arthropathy of the foot and ankle is to correct the deformity so that there is appropriate distribution of pressure for healing and prevention of skin ulceration. Conservative treatment using a total contact cast may result in an unsatisfactory outcome because of inadequate fixation, a high rate of infection, a compromised blood supply and nonunion. Open correction with internal fixation for Charcot osteoarthropathy is associated with a high rate of complications and failure because of infection, bone softening, resorption, fragmentation and breakage of the implant.

The main advantages of using an Ilizarov external fixator in the treatment of Charcot osteoarthropathy are the ability to gradually correct deformity in the post-operative
In our study, 20 patients with a stage-II Charcot osteoarthropathy underwent arthrodesis of the foot and ankle with an Ilizarov external fixator and obtained anatomical reduction and stable fixation without major complications. Wang, Le and Tsukuda\(^1\) had comparable results within 3.1 months and Cooper\(^1\) reported successful arthrodesis within 4.2 months. Farber et al\(^1\) had a mean time to fusion of nine weeks in their series followed by the application of a total contact cast for a mean of 19 weeks without subsequent ulceration. In a series reported by Simon et al\(^1\), patients were able to resume wearing regular shoes within 27 weeks.

Correction and stabilisation of foot and ankle deformities with an Ilizarov external fixator are effective and allow correction of the deformities, while avoiding the complications of internal fixation. It also enables early weight-bearing, care of soft tissues, prevention of skin ulceration and avoidance of amputation. However, it is recognised that Ilizarov external fixation is not without some disadvantages since it involves a lengthy duration of treatment, is commonly associated with pin-track infection and requires surgical expertise and dedicated instrumentation. Nevertheless, these problems are outweighed by the advantages of the technique.

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References