

Review

Charcot Neuroarthropathy in Patients With Diabetes: An Updated Systematic Review of Surgical Management



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ABSTRACT

Charcot neuroarthropathy (CN) of the foot and ankle is a demanding clinical dilemma, and surgical management can be very complicated. Historically, the evidence guiding surgical management of CN has been small retrospective case series and expert opinions. The purpose of the present report was to provide a systematic review of studies published from 2009 to 2014 and to review the indications for surgery. A Medline search was performed, and a systematic review of studies discussing the surgical management of CN was undertaken. Thirty reports fit the inclusion criteria for our study, including 860 patients who had undergone a surgical procedure for the treatment of CN. The surgical procedures included amputation, arthrodesis, debridement of ulcers, drainage of infections, and exostectomy. The midfoot was addressed in 26.9% of cases, the hindfoot in 41.6%, and the ankle in 38.4%. Of the 30 studies, 24 were retrospective case series (level 4), 4 were controlled retrospective studies (level 3), and 2 were level II studies. The overall amputation rate was 8.9%. The quality of the published data on the surgical management of CN has improved during the past several years. Evidence concerning the timing of treatment and the use of different fixation methods remains inconclusive.

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Charcot neuroarthropathy (CN) of the foot and ankle is a destructive process that poses an immense challenge to foot and ankle specialists. The development of neuropathic fractures and/or dislocations in the foot and ankle predisposes the patient to increased morbidity, decreases patient-reported quality of life, and increases the risk of foot ulceration and potential for major amputation (1,2). Early recognition and intervention is imperative to prevent permanent deformity, ulceration, and the possibility of limb loss.

Although any disease process that results in peripheral neuropathy can lead to CN, this condition is currently most closely associated with diabetic peripheral neuropathy and was first linked to diabetes mellitus (DM) by William Riely Jordan in 1936 (2). The American Diabetes Association has estimated that 29 million people in the United States, or 9.8% of the population, have DM (3). Of these patients with DM, 14.5 million people, or 4.9% of the

population, will develop peripheral neuropathy (4). The precise incidence of CN is unclear but might affect 8.5 per 1000 people with DM annually (5).

The initial treatment of CN in the foot and ankle traditionally has been nonoperative, using offloading devices such as total contact casting, Charcot restraint orthotic walker devices, and bracing (2,6). The goal of treatment, whether operative or nonoperative, is to achieve a plantigrade foot with osseous stability (2,7). A stable plantigrade foot can reduce the likelihood of ulcer formation, which, in turn, can reduce the rate of infection and amputation. Pinzur (8) has demonstrated that 60% of patients with midfoot CN achieved a desired endpoint without the need for surgery. However, when surgical intervention is necessary, the published data to guide treatment decisions have been based on noncontrolled retrospective case series, case reports, and expert opinion (9).

A systematic review by Lowery et al (9) examined all the published data regarding the surgical management of CN from 1960 to 2009. At that time, all published data on this topic was from retrospective case studies, expert opinions, or case reports (level 4 or 5 evidence). No study directly compared different fixation methods, timing of surgical intervention, or the outcomes of patients who had undergone amputation. The purpose of the present systematic review was to provide an update on the current trends regarding the surgical

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management of CN and to determine whether the quality of the published data has improved since 2009 (9).

Materials and Methods

A Medline search was performed from July 1, 2009 to June 23, 2014 using the key terms of *Charcot*, *arthropathy*, *neuroarthropathy*, *neuro-osteoarthropathy*, and *surgery*. The abstracts of all studies cited were reviewed, and the studies that reported on the surgical management of CN were included for further review.

Inclusion Criteria

Included in the study group was any report written in English that discussed the surgical management of CN of the foot and ankle secondary to DM, including reviews and retrospective case series.

Exclusion Criteria

Excluded from the study group was any report that was not written in English and any that did not discuss the surgical management of CN. Studies that discussed patients with nondiabetic causes of CN (ie, leprosy, syringomyelia, syphilis, and alcohol) were excluded as were those describing CN in areas of the body other than the foot and ankle.

Results

The search was performed in June 2014. For the purposes of the present study, the terms *Charcot arthropathy*, *neuroarthropathy*, and *neuropathic arthropathy* were used interchangeably. The search results are summarized in Figs. 1 to 3. A total of 209 reports were cited during a 5-year period (2009 to 2014). Of these reports, 30 met the criteria for inclusion in the present review (10–39). Of the 30 studies, 2 (6.6%) were level 2 prospective comparative studies, and 4 (13.3%) were level 3 retrospective case-controlled studies. The remaining 24 studies (80%) were level 4 case series. Level 5 studies were not included for statistical interpretation in the present study; however, some expert opinions were used for discussion purposes.

The surgical procedures performed included amputation, arthrodesis, debridement of ulcers, drainage of infections, and exostectomy. The use of internal or external fixation and the need for posterior muscle group lengthening were recorded.

Overall, 860 patients were reported to have undergone a surgical procedure for the management of CN during the study dates. The number of patients reported per study ranged from 1 to 195, with a mean and median number of patients per study of 28.6 and 11, respectively.

Of the 860 procedures, 330 involved the ankle (38.4%), 358 involved the hindfoot (41.6%), 231 involved the midfoot (26.9%), and 2 specifically involved the forefoot (0.2%). The percentages do not equal 100%, because some patients required surgery at >1 anatomic region. In 3 studies, the exact location of the surgery was not identified. These

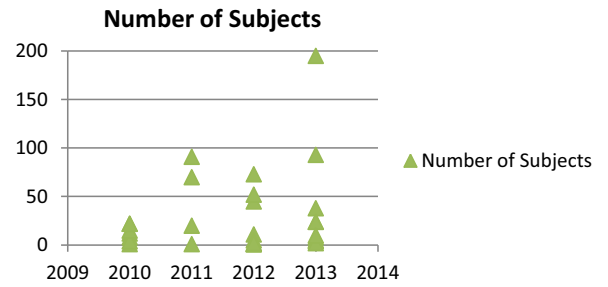


Fig. 2. Number of subjects per study.

3 studies accounted for a total of 278 surgical procedures. Of these surgeries, 307 used internal fixation (35.7%) and 427 involved the application of an external fixation device (49.7%). In addition, 196 of 860 (22.8%) also included tendo-Achilles lengthening. Of the 30 studies, 22 included joint arthrodesis as a treatment option, either alone or in addition to another procedure. A total of 77 amputations were performed, for an overall amputation rate of 8.9%. Not all the studies were consistent in defining fusion using radiographic or clinical parameters; thus, a determination of nonunion rate would be difficult.

Two studies compared the use of internal versus external fixation (15,17). One additional study discussed surgical versus nonsurgical treatment options (11). Also, 2 studies compared surgical correction versus amputation for patients with CN (11,29). One report discussed CN of the first metatarsophalangeal joint, which was treated with arthrodesis through a dorsal locking plate (38). Also, 1 study directly compared the cost of limb salvage versus amputation in patients with CN (21).

Discussion

Patients with CN encounter increased morbidity and a decreased quality of life (1). The Medical Outcomes Study 36-item Short Form survey physical component scores in patients with CN are 1 standard deviation lower than those of patients with end-stage renal disease requiring hemodialysis, cardiovascular disease, and Parkinson's disease. Another recent study reported that patients with CN had Foot and Ankle Ability Measurement scores that were 2 standard deviations lower than a control group of diabetic patients without CN (40). Patients with CN have an increased risk of major amputation, with rates as high as 28% if ulceration is present on the initial evaluation (41). The amputation rate in the present systematic review was 8.9%, similar to the 7% rate reported in an additional study (41). Sohn et al (42) found that patients with CN patients and foot ulcers were 12

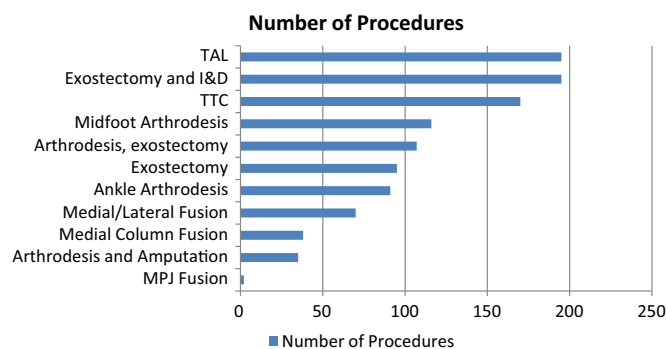


Fig. 1. Number of described surgical procedures. I&D, incision and drainage; MPJ, metatarsophalangeal joint; TAL, tendo-Achilles lengthening; TTC, tibiototalcalcaneal.

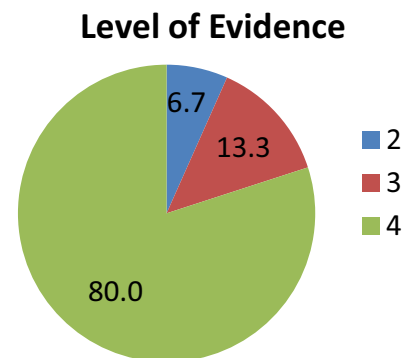


Fig. 3. Evidence levels of studies discussing surgical management of Charcot neuroarthropathy.

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